

PROVINCE OF ALBERTA
DEPARTMENT OF AGRICULTURE

BULLETIN NO. 1

STUDIES IN
OUR COMMON GRAINS

(For use in connection with Grain Judging Schools)

Published by Direction of
HON. W. T. FINLAY, MINISTER OF AGRICULTURE



EDMONTON:
JAS. E. RICHARDS, GOVERNMENT PRINTER
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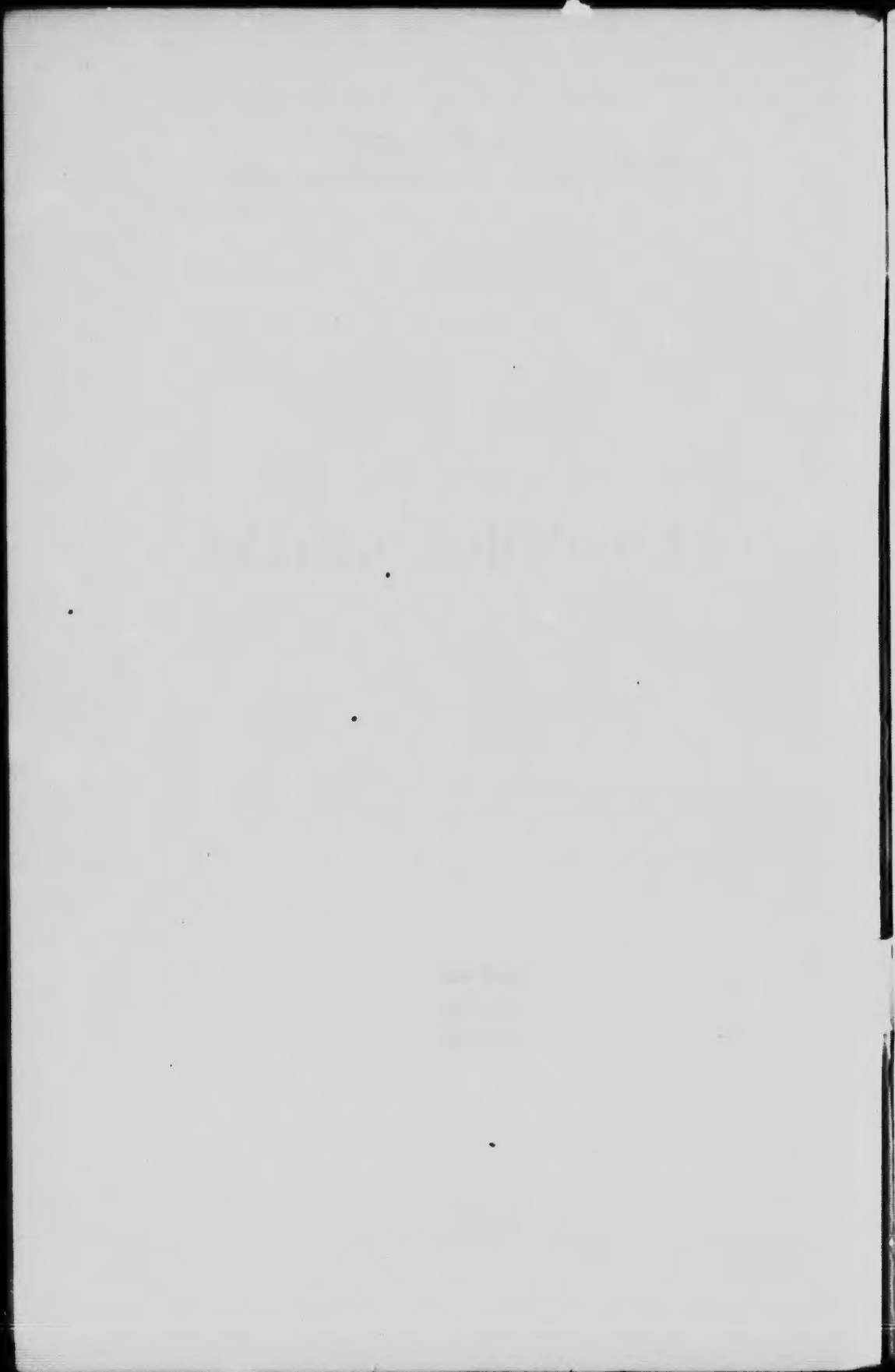
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HON. W. T. FINLAY,
Minister of Agriculture,
Edmonton.

Sir,—

I have the honour to submit herewith Educational Bulletin No. 1, entitled "Studies in Our Common Grains," for use in connection with the grain judging schools about to be held in the Province. The Bulletin is the joint work of Messrs. Arch. Mitchell, Chief Inspector of Weeds; H. A. Craig, Superintendent of Fairs and Institutes; T. B. R. Henderson, Librarian, and the writer, all of your own Department, and Mr. W. C. McKillican, representative of the Seed Branch of the Dominion Department of Agriculture.

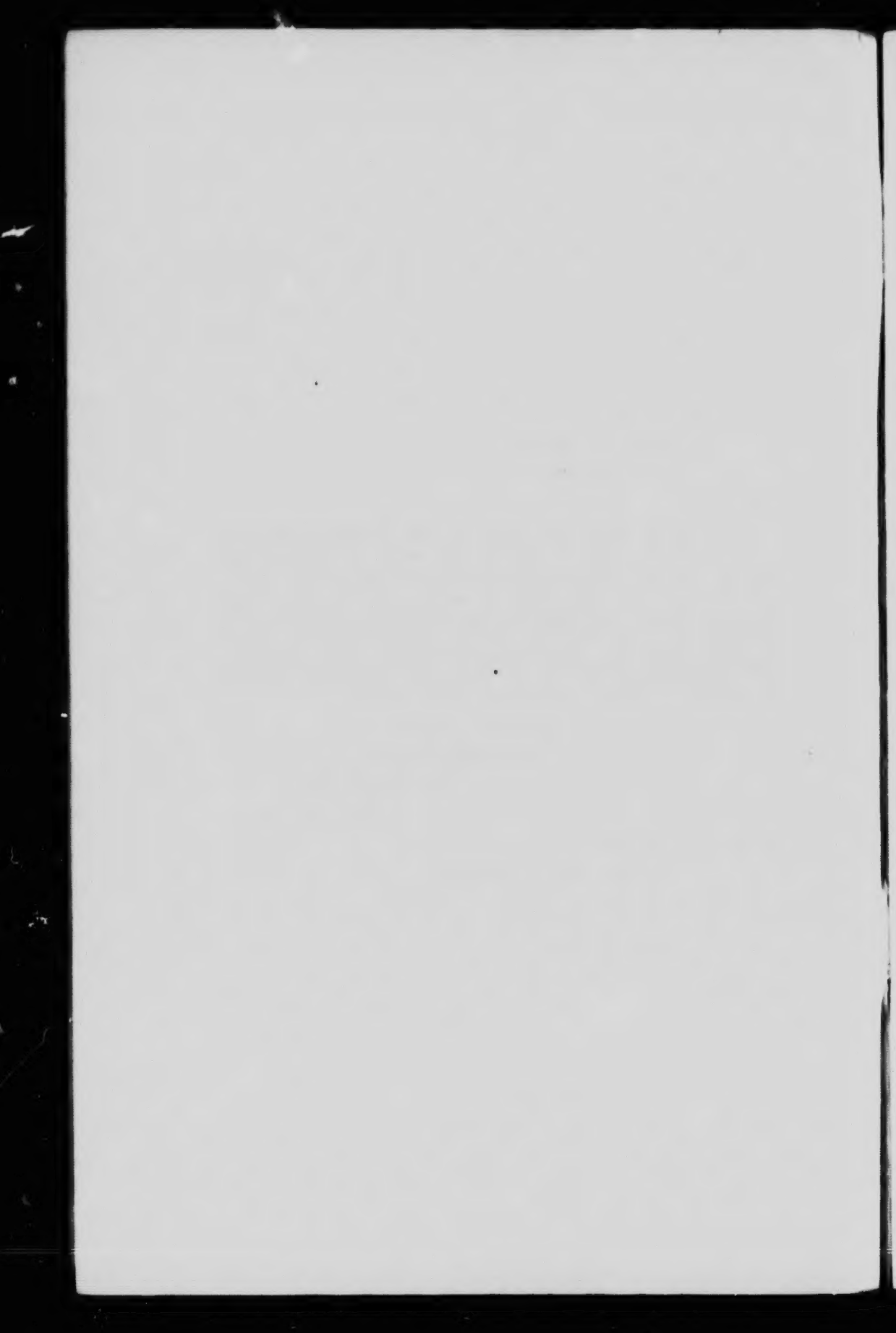
I have the honour to be, Sir,

Your obedient servant,

GEO. HARCOURT,
Deputy Minister.

DEPARTMENT OF AGRICULTURE

Edmonton, January 2nd, 1908.



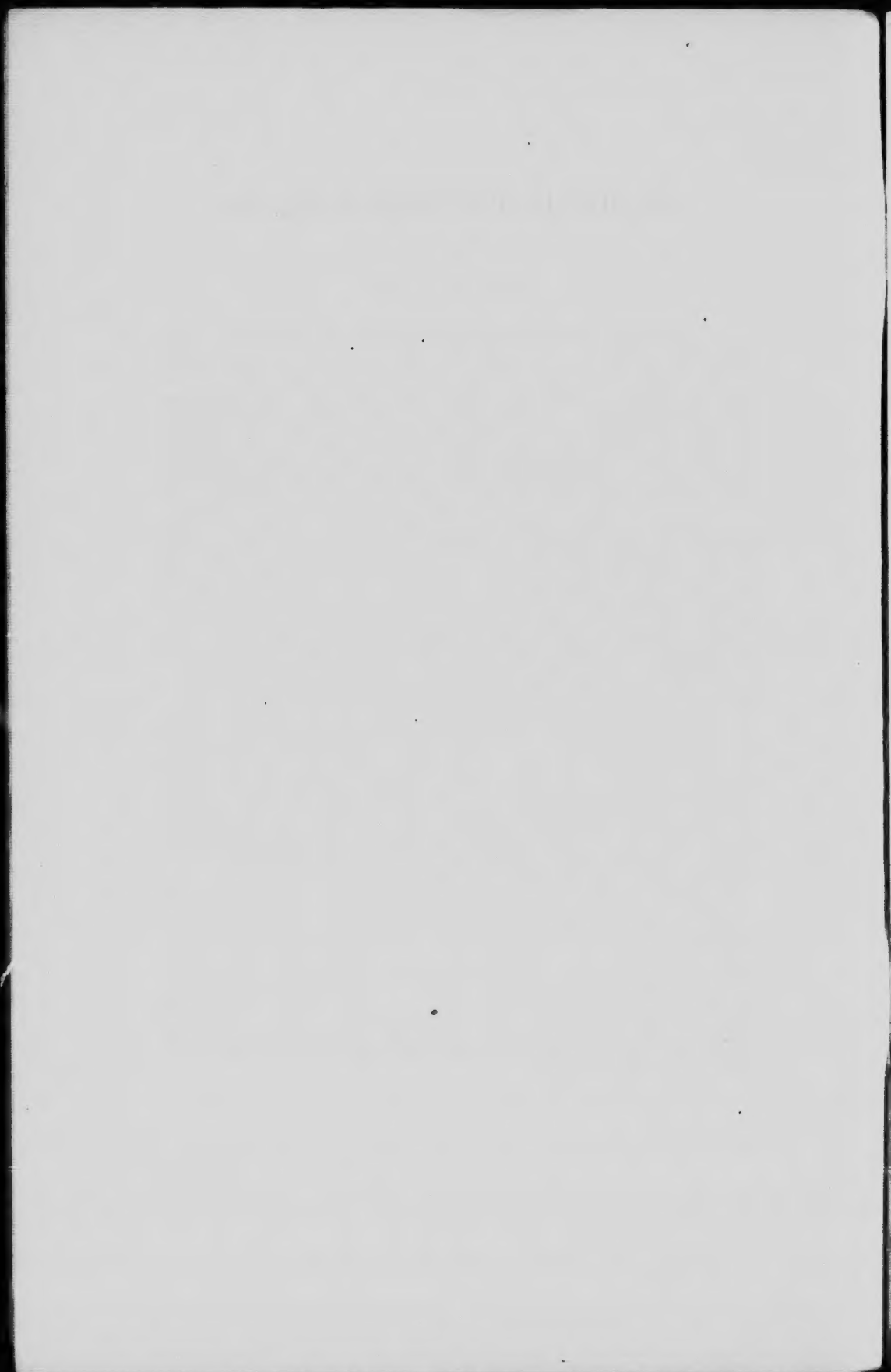
STUDIES IN OUR COMMON GRAINS.

INTRODUCTION.

This Bulletin is compiled for the purpose of presenting in concise form a summary of the essential facts about our common grains which every farmer should know. While intended primarily for use in connection with the grain judging schools, it is hoped that the facts presented may be of value to many a farmer who is unable to take advantage of these schools. The studies are not intended to be exhaustive, as would be required for class room work at college, but to give in a somewhat popular form the essential features about the common grains every farmer grows,—wheat, oats and barley.

In the growing of crops the aim should be to obtain on a given area a maximum quantity of the best quality at a minimum cost. In accomplishing this end there are many factors to be considered, as crops are not produced by chance, nor are desirable results obtained without effort. Much can be done by proper methods of farming to enhance the yield, but to obtain the best results a man must understand thoroughly what he is doing, otherwise his labour and time might be turned to better account. In grain growing it is always well to remember the old adage, that as we sow so shall we reap.

Because one variety of grain appears to be specially suited to a particular locality it does not follow that the same variety will be equally suitable in another, though it may not be many miles distant. Even on the same farm a certain variety may be better adapted to certain parts of the farm than others and may not do as well if sown on other portions. Here it should be emphasized that it will cost no more in labour or time to grow the best yielding variety procurable than a poorer one. It is astonishing what a small increase in the yield of grain per acre would mean in the total crop of Alberta. The estimated area in crop in 1907 was 711,648 acres. Supposing two bushels per acre were added to the yield of each class of grain by selection of more suitable varieties and intelligent cultivation, it would mean an increase in the total yield of grain of 1,423,296 bushels. This increase is quite possible and emphasizes the importance of sowing that variety of grain which will give the highest possible yield, and of cultivating and handling the land in such a way as to assist that particular variety to accomplish the utmost it is able to do.



Section I.—WHEAT.

1.—CLASSIFICATION AND VARIETIES.

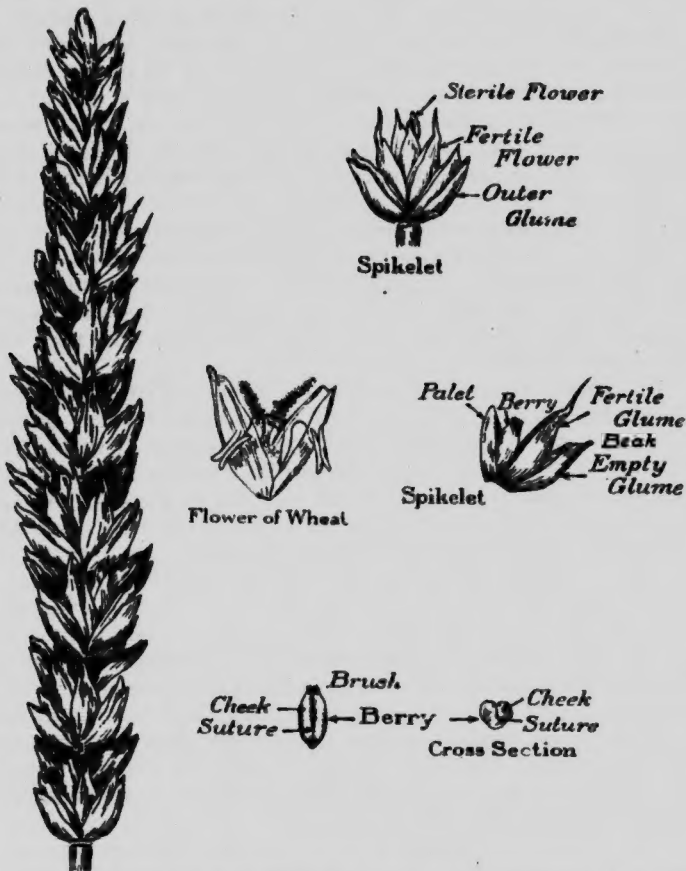
Wheat is the most important of our cereal crops, and just now "Wheat is King" in the prairie provinces. How long he will reign remains to be seen, but the rapidity and ease with which land can be broken and cropped on the open prairies will ensure for him many years of uninterrupted sway. Many farmers scout the idea that he will ever be dethroned and maintain that it is impossible to deplete the enormous store of fertility in the virgin prairie soils by continuous wheat growing. In this connection a brief review of the history of wheat growing on the continent is not only interesting but highly profitable. A century ago the famous wheat-growing district on the continent of America was the great Genesee Valley of New York State, but continuous wheat cropping so depleted the fertility of the soil that it became no longer profitable, and a quarter of a century later Ohio sprang into prominence as the great wheat-growing State of that union; then it was Illinois, Indiana, Iowa, and north into Wisconsin, Minnesota and the Dakotas with extending settlement. In the early seventies the first rush towards the Canadian prairies was made, and it is still going on faster than ever. Our wheat has come to the front as being of superior quality to that grown south of the line, and there is no doubt this proud position will be held until the store of available fertility in the soil has been exhausted, when the banner will move westward and northward to the newer districts.

The significant fact in this history of the wheat movement is that from twenty-five to thirty years of continuous wheat growing impoverished the virgin soils to such an extent that both the yield and quality of grain became so reduced that it was no longer possible to supply the quality of wheat that the millers wanted, and they were obliged to look for it elsewhere. These districts were then forced into some form of stock raising or dairying, and to-day the farms, having been built up, are again growing wheat of high quality, though possibly not in such large quantity. We have no reason to expect any better fortune, and sooner or later those prairie soils which are now devoted to continuous wheat growing will without a doubt become depleted. It is already being felt in the older settled portions where the yield is not nearly so large as it was some years ago, nor the grade obtained as high. There are other districts where it was once claimed that the soil was too rich for manure, where a liberal dressing of manure is considered a necessity not only to improve the yield but the quality of the product.

Wheat belongs to the grass family, or the botanical order *Gramineae*. It is probably a native of South Western Asia and has been cultivated for many thousands of years. The Chinese claim that wheat was used as food by them 2,700 years before the Christian

Era, and in Egypt it would appear to have been used as food prior to that (See Ex. 9, 31). It certainly is of ancient origin and was cultivated by prehistoric races in Europe, as remains of wheat grains have been found in the ruins of the lake dwellings in Switzerland.

Wheat grows in a variety of soils and likes a rich alluvium or soil composed of disintegrated rock mixed with vegetable mold. Our prairie soils being largely of glacial formation, contain a good mixture of pulverized rock overlaid by a layer of vegetable mold more or less intermingled with it. Wheat thrives best on soils rich in humus or decaying vegetable matter. As this vegetable matter decays nitrogen is liberated, and as it is one of the principal foods required by wheat it is readily seen why our prairies are yielding so abundantly. It is equally obvious that with a diminishing supply of decaying vegetable matter in the soil reduced yields must be expected, unless some effort is made to restore the drain occasioned by continuous wheat growing.



On the left is shown a head of winter wheat (Dawson's Golden Chaff) and on the right the structure of the spikelet is given with the various parts named. Note the number of grains in a spikelet and how well filled the head is at both bottom and top.

The members of wheat branch, and practically all the members of the grass family, have herbaceous stems, round, jointed and hollow except at the joint, or node as it is termed. The stems bear alternate two-ranked leaves with the sheath split on the opposite side of the culm or stalk. The fruit, or seed, is borne on a zigzag rachis as the stem or stalk of the wheat head, or ear, is called. At each notch of the rachis a spikelet is attached. Each spikelet contains from two to five flowers, one or more of the upper ones being nearly always sterile or abortive. The lower spikelets of the ear, or head, are frequently abortive, as also some at the top. A peculiarity Western Canadian wheat heads is the remarkable absence of sterile flowers, fertilization being almost perfect throughout the whole length of the head. Not only is fertilization perfect from end to end of the head but each flower of the spikelet is also fertilized, there being usually four well-developed grains and one partially formed instead of a sterile flower. This almost perfect fertilization is one reason why the yields of wheat are so large.

Examine a head and note the number of grains in a spikelet and the manner in which they are filled.

The outside chaff or empty glume is broad and usually has a short awn or blunt apex called the beak. The chaff next to the grain, or flowering glume as it is called, may have a long, or short blunt awn. The fruit, or berry of grain, is free from the glumes, has a deep furrow on one side called the crease, and is hairy at the top. The fruit may be red, brown, yellow, violet, or white in colour.

Classification.—Owing to the long period during which wheat has been cultivated, and to its susceptibility to change through environment, many forms have been developed. These all come under one subfamily or genus of the order *Gramineae*, called *Triticum*, which can be again divided into three leading groups or species. The following classification will show the relation existing between the various members of this family:

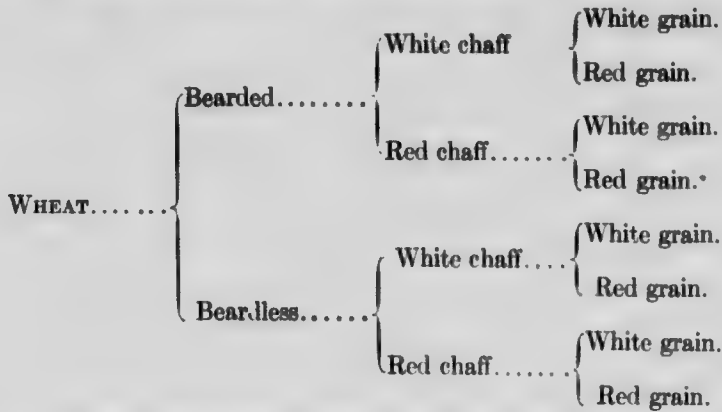
ORDER GRAMINEAE, GENUS TRITICUM.

Species:—

1. *Monococcum* (1 grained), spikes compact, spikelets 3 flowered but 1 grained, bearded, very ancient kind of wheat and not now considered a good wheat for bread, e.g. Einkorn.
2. *Polonicum* (Polish wheat, corn wheat), heads open and long, two or three seeds in a spikelet, bearded, empty glumes long, seeds extra long bright and shiny, cultivated in Europe and Africa.
3. *Sativum*.
 - (a) *Vulgare* (common wheat), spikes rather compact, spikelets five flowered, three to five grains in a spikelet, some bearded and some beardless, grown extensively in America.
 - (b) *Compactum* (dwarf wheat, club wheat), spikes short, four sided, large at the apex, some bearded, some beardless, grown in Switzerland, Chili and some parts of America.

- (c) *Turgidum* (Egyptian wheat), spikes large, four sided, two to three seeded spikelets, bearded, grown in Egypt and Germany.
- (d) *Durum* (true bearded), spikelets long, stiff awns, three to four seeded spikelet, seeds large angular and bright, used in the manufacture of macaroni, flour makes dark bread, grown in Europe and Africa and more recently in America.
- (e) *Spelta* (spelt), spike long, loose dark coloured, spikelets 3 seeded at base of spike 2 at top, rachis breaks up in threshing, a portion coming off with the spikelet, empty glumes lie close to flowering glumes, flowering longer than empty glumes, very slight keel on empty glume. The small piece of the rachis adhering to the spikelet is rather long and blunt, chaff adheres to the grain, grown in Europe and Asia, lately introduced into America.
- (f) *Dicoccum* (Emmer), spike compact, dark coloured, rather short, bearded, spikelets two seeded, spikelets lapping closely over one another, empty glumes shorter than flowering glumes, empty glumes keeled, a small piece of the rachis adheres to the spikelet, it is short and pointed, the seed is flat on front, convex on back, very hard, flinty.

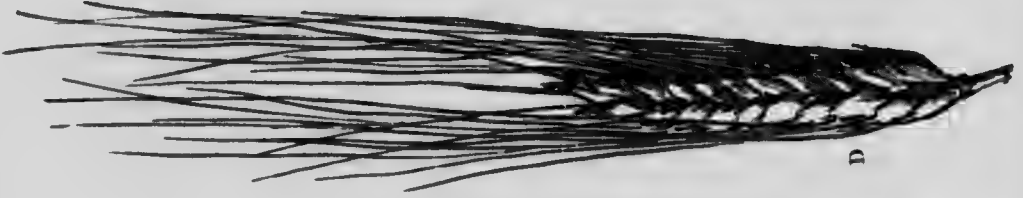
Popular classification of Common Wheat (*Triticum vulgare*):



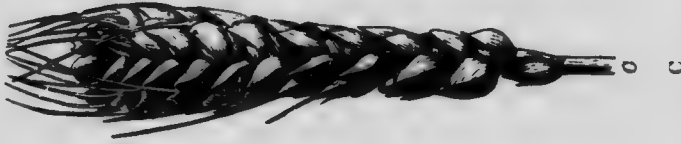
Wheat may also have smooth (glabrous) chaff or velvety (pubescent) chaff.

Another classification of wheat may be made as follows:

HULLESS	{	<i>Triticum vulgare</i>	Common wheat or flour wheat.
		<i>Triticum durum</i>	Macaroni wheat.
WHEATS.	{	<i>Triticum turgidum</i> ...	Poulard, Rivet, or Egyptian
		<i>Triticum polonicum</i> ..	Polish wheat. [wheat.
HULLED	{	<i>Triticum spelta</i>	Spelt.
WHEATS.	{	<i>Triticum dicoccum</i> ...	Emmer.
		<i>Triticum monococcum</i> ,	Einkorn or one grained wheat



D



C



B



A

FOUR TYPES OF WHEAT HEADS
 A--Red Fife; B--Alberta Red, or Turkey,
 or Turkey Red; C--Club Wheat; D--
 Durum or Macaroni.

Wheats may also be classed into winter and spring varieties. All of the winter varieties belong to the species *Triticum vulgare*.

Varieties.—The following are some of the common varieties of wheat grown in Alberta:

Spring Wheat.—Red Fife, White Fife, Preston, Stanley, Percy, Harrison's Bearded, Huron.

Club Wheat.—Little Club.

Macaroni Wheat.—Goose, Roumania.

Spelt.—Red Spelt, White Spelt.

Emmer.—Common Emmer, Red Emmer.

Winter Wheat.—Turkey, or more properly Turkei Red, or as it is now called Alberta Red, Kharkoff, Dawson's Golden Chaff, Odessa, Clawson's White, Early Genessee Giant.

RESULTS OF VARIETY TESTS AT BRANDON AND INDIAN HEAD FARMS.

1905.—COMMON WHEAT.

BRANDON	Days matu ring	Yield per acre		INDIAN HEAD	Days matu ring	Yield per acre	
		Bus.	Lbs.			Bus.	Lbs.
Preston.....	136	52		Minnesota No. 163....	144	46	
Laurel.....	138	47	40	Huron (Ottawa seed) ..		43	40
White Fife.....	141	47	20	Hayne Blue Stem			
				Minn. 169.....	147	43	40
Huron.....	136	47		White Fife.....	147	43	20
Advance.....	138	46	40	McKendry's Fife			
				Minn. 181.....	147	43	
Red Fife.....	141	45	20	Bishop.....	142	43	
Wellman's Fife.....	142	45		Wellman's Fife.....	145	43	
Haynes' Blue Stem.....	141	44	40	Dawn.....	135	41	40
Power's Fife.....	139	44		Percy (Ottawa Seed) ..	141	41	40
Minnesota No. 163.....	141	43	40	Australian No. 9.....	144	41	20

MACARONI WHEAT.

Yellow Gharnovka	139	54		Goose.....	144	54	40
Roumanian.....	145	50		Yellow Gharnovka....	144	52	

EMMER AND SPELT.

Common Emmer.....	137	2,840		Red Spelt.....	142	3,420	
Red Emmer.....		2,500		White Spelt.....	142	3,340	
Red Spelt.....		2,500		Red Emmer.....	144	3,040	
White Spelt.....		2,280		Common Emmer.....	142	2,940	

1906.—COMMON WHEAT.

Preston.....	122	44		Preston.....	130	46	
Red Fife.....	125	40		Stanley.....	130	45	20
White Fife.....	125	35	10	White Russian.....	128	41	
Huron.....	121	43	50	Percy.....	130	41	20
Pringle's Champlain....	120	41	50	White Fife.....	136	48	40
Percy.....	120	34	50	Huron.....	128	42	20
Stanley.....	121	35	10	Red Fife.....	136	43	40
White Russian.....	124	31	20	Laurel.....	137	43	40
Harrison's Bearded.....	121	34	30	Red Fern.....	132	42	
Laurel.....	124	25	40	Colorado.....	131	39	40

MACARONI WHEAT.

Goose.....	127	56	20	Goose.....	134	51	40
Roumanian.....	126	54	20	Roumanian.....	136	47	40

EMMER AND SPELT.

Common Emmer.....	126	3,820		Common Emmer.....	128	3,220	
Red Spelt.....	129	3,180		Red Spelt.....	130	3,600	
Red Emmer.....	132	3,000		White Spelt.....	131	3,160	
White Spelt.....	130	2,740		Red Emmer.....	131	2,980	

1907.—COMMON WHEAT.

Red Fife.....	123	44		Marquis B.....	135	32	
White Fife.....	124	42	40	Colorado.....	135	25	20
White Russian.....	123	40	20	Preston A.....	130	25	20
Huron.....	118	39	40	Bishop.....	130	23	20
Riga.....	117	39	40	Pringle's Champlain....	135	23	
Harrison's Bearded.....	122	39	10	Percy A.....	130	21	40
Stanley.....	119	39		Huron.....	130	21	
Bishop.....	116	38	10	Stanley A.....	132	19	40
Preston.....	119	37	30	Chelsea.....	132	19	20
Pringle's Champlain....	116	37	20	Harrison's Bearded....	137	19	..

MACARONI WHEAT.

Goose.....	125	44	20	Goose.....	134	31	40
Roumanian.....	120	45	40	Roumanian.....	134	31	

EMMER AND SPELT.

Common Emmer.....	127	2,820		Red Spelt.....	129	2,200	
Red Spelt.....	129	1,940		Common Emmer.....	130	2,020	
Red Emmer.....	126	1,930		White Spelt.....	129	1,560	
White Spelt.....	129	1,720		Red Emmer.....	130	1,320	

2.—GERMINATION AND STRUCTURE.

Soak a number of grains of wheat in water until well swollen out. Examine the furrow, crease, or suture on the back of a grain,—the other side being called the belly. The sides of the crease are called the cheeks. Note the bearded tip which is called the brush. This is supposed to carry moisture during development as the hairs are hollow.

If allowed to remain damp a day the embryo or germ can be readily seen through the semi-transparent skin at the base of the grain on the opposite side of the furrow. The embryo or germ can be easily removed by cutting round it with a needle.



WHEAT BERRIES showing the germ or embryo in two ways; also two cross-sections, one at the germ and the other through the centre, showing the cross or suture.

Place some of the soaked grains in a damp piece of folded blotting paper, cover with a tumbler, and allow them to germinate. Watch them. Note how the three little roots start out and also the plumule, as the shoot is called, from which springs the first green blade. During the process of germination the food stored in the berry around the germ or embryo is softened and changed from an insoluble form to a soluble one ready for absorption as the plumule and roots expand. By watching the growth and development of shrunken and plump grains one can readily see why plump grain is wanted for seed. The young plant depends upon this store of reserve food to give it a start in life, and it is intended to carry the plant along until its tiny root system has attained such size and power as to enable it to take up plant food from the soil itself. The most critical period in the life of the young plant is at the *weaning stage*, i.e., just when the reserve of plant food is exhausted and the young plant is thrown upon its own resources. This is a poor stage to have winter wheat reach just as winter comes on. The first or primary roots usually die after a secondary set have been formed.

While at first only a single blade shows, later the plant sends up quite a number of shoots. This process is called *tillering* and is a common mode of branching in all cereals. Some species tiller



A NEWLY GERMINATED GRAIN OF WHEAT showing the three rootlets starting out and the plumule. The right hand picture shows a later development.



A YOUNG WHEAT PLANT BEGINNING TO TILLER.

more than others. Thus wheat and barley tiller more than oats. Plenty of light, and also thin sowing, tends to increase tillering. There is less tillering in poor soils than in good ones. Winter wheat tillers more than spring.

Structure of the Wheat Berry.—The accompanying illustrations will serve to explain the structure of the wheat berry. The outer covering or husk, commonly called bran, is composed of some three separate layers. The outer covering is called the pericarp or epidermis; the second covering or episperm, which is just without the perisperm, consists of the outer and inner integuments. The third bran layer is called the perisperm and is a thin mass of collapsed cells. Underneath the bran layers lies the aleurone layer, largely



A cross-section of a young wheat plant just tillering, showing that the young shoots contain the whole future form of the plant ready to shoot up.

composed of gluten cells. Inside this layer is the endosperm, or floury portion of the wheat, or starch cells, which compose fully 78 per cent. of the kernel. The germ, or embryo, makes about 6 per cent., the aleurone layer about 6 per cent., and the bran 10 per cent. The ratio of each to each other vary in the different kinds and varieties of wheat.

The germ is found at the larger end of the kernel, and, being darker in colour than the starch cells of the endosperm, is removed in the process of milling so as not to darken the flour. It constitutes

a large proportion of what is called wheatlets and sometimes germ meal. It contains oily matter and is very rich in proteids or gluten compounds.

The English chemist Warrington estimates that a crop of wheat yielding 30 bushels per acre will remove 35 lbs. of nitrogen, 14.2 lbs. of phosphoric acid, and 9.3 lbs. of potash from the land. The amount taken by a similar crop here will be fully as much if not greater in nitrogen. These are the three foods which plants have the greatest difficulty in obtaining and for which all manures are valuable. In this connection attention should be called to the value of bran not only as a food for stock, but to its richness in the plant foods above mentioned. A ton of bran contains on an average about 48 lbs. of nitrogen, 55 lbs. of phosphoric acid, and 30 lbs. of potash. Valued as a commercial fertilizer it is worth \$10 to \$12 per ton to sow on the land and plow down. If, however, it is fed to stock, about 90 per cent. of the fertilizing value is returned in the excreta after the full feeding value has been obtained.

Flowering and Fertilization.—Most cereals open their flowers in the morning,—from four to seven o'clock and only when the temperature rises to about 75° F. In wheat, oats and barley self-pollination or self-fertilization is the rule and is always followed by fertile seeds. In wheat the first flowers to open are those about one-third of the way from the apex of the ear. The rest follow in succession upwards and downwards from this point. Each flower remains open from half to one hour, and the whole ear completes its flowering usually in eight or nine days.

In barley the complete period of flowering is shorter, but the flowers remain open a longer time than those of wheat. The flowers of barley frequently never open at all, and self-fertilization then must be the rule. The fact is that self-fertilization is the rule with all the cereals except rye. Natural crosses among wheats and among oats have been observed occasionally.

3.—MILLING QUALITIES.

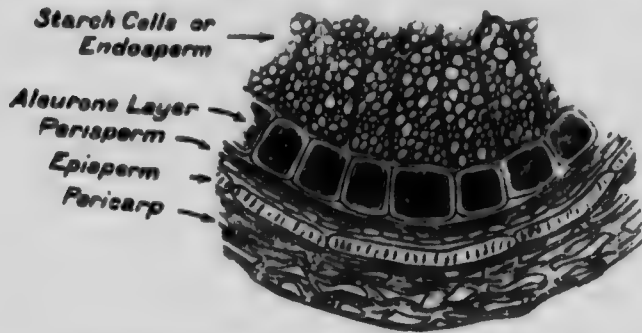
In order to understand more clearly what is required for a good wheat for milling purposes it is necessary to know the nature of the demands of the market for flour and how the miller aims to manufacture a product that will meet this demand. In the first place the public demand a white flour, and in the second place one with sufficient strength for bread-making purposes to make a good sized loaf. For pastry purposes the flour must be good, but strength is not essential.

To obtain a white flour the miller removes the bran coatings, also the aleurone layer of gluten cells underneath the bran. The gluten is darker in colour than the starch of the body of the kernel, hence it tends to darken the flour and is therefore removed. So also is the germ, as it is rich in gluten and oily substances, and would also make the flour dark in colour. The body of the kernel—the endosperm—supplies the flour. The processes of modern milling are quite intricate and some idea of the degree of perfection that

has been attained may be gathered from the fact that one Minneapolis mill separates out 72 grades of product from one sample of wheat.

The bye-products are bran, shorts, middlings and wheatleas. Shorts in modern milling are really reground bran. Middlings consist of the finer parts of the bran, the aleurone layer, some flour and frequently the germ. In all, the offal amounts to about 25 per cent. of the original weight.

It is readily seen, therefore, that a wheat to produce a flour which will meet the requirements must contain as large a percentage of starch cells in such form as will make the desired article. Wheat is greatly influenced by the character of the soil and the climate of the country it is grown in. The variety also plays a part, as, for instance, the Lodoga wheat once advocated on account of its earliness, will not make the high quality of flour demanded by the market. Yet crossed with the Red Fife we have the Preston and Stanley wheats and with the White Fife the Percy and Huron. All of these varieties—the best of many crosses—are considerably earlier than



PORTION OF A CROSS SECTION OF A GRAIN OF WHEAT SHOWING a bran scale with a portion of starch cells adhering.

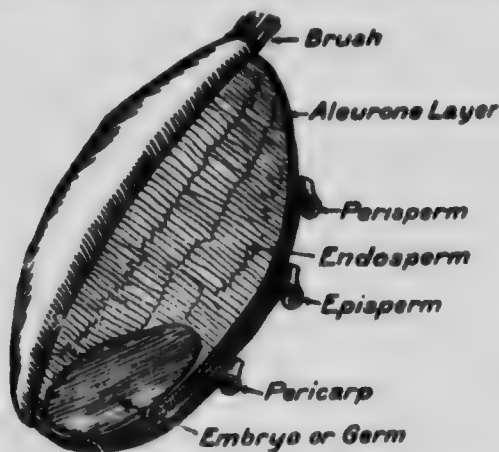
the Fife wheat. They are hardy, and claimed by some equally as suitable for the manufacture of flour. Some millers, however, will not buy these varieties if they know it, so strong is the prejudice against Lodoga wheat and everything related to it. Milling tests have shown them to be the equal of Red Fife. It cannot be denied though that we could do with an earlier wheat than Red Fife. At the same time it is admitted on all sides that it has no equal in hardness and general suitability to the country with the one exception of earliness.

Gluten.—Next to a beautiful white flour the most important point is what is called strength. It is indicated in the term "strong bakers." Strength refers to the gluten in the flour and means the capacity to make a large loaf and is associated with the power to absorb water. Starting with equal weights Western Canadian wheat flour will absorb more water than flour made from English wheat. This amounts to one or more loaves to a sack and is an important item. In the matter of strength the wheat produced on the prairies of Western Canada beats that of any other country.

This is the reason why our hard wheats are so much in demand for mixing with the softer varieties of other places.

If a few grains of wheat are chewed continually a tough elastic substance is obtained which is practically gluten. In the laboratory a given weight of flour is enclosed in a fine cloth and then gently kneaded in water until no more starch can be washed out. The weight of this is the gluten. It is the leading constituent of the proteid compounds of wheat and hence of the greatest value in a flour for bread making.

Besides being found in largest quantities in the aleurone layers and in the germ, it is found that the starch cells are intimately associated with the gluten cells throughout the endosperm or body of the kernel. The gluten is made up of two constituents, gliadin and glutenin. Gliadin is described as a viscous, sticky substance like glue, soluble in a 70 per cent. alcohol solution and can be obtained



A GRAIN OF WHEAT cut through at the crease, or suture, showing the various coatings making up the bran rolled back, the embryo, the aleurone layer and the brush.

	Bran Pericarp Epiperm Perisperm
Middlings.....	Aleurone layer or Gluten Cells
Flour.....	Endosperm

by evaporation in thin flakes like gelatin. The other constituent of gluten—glutenin—is that which gives it toughness. It is insoluble in water, alcohol and salt solution, but soluble in dilute alkali. It has been claimed that the value of a flour for bread making purposes depends upon the ratio which the glutenin in the gluten bears to the gliadin. Professor Snyder of the Minnesota Experiment Station says: "A well balanced gluten is composed approximately of 65 per cent. gliadin and 35 per cent. glutenin." Other investigators place the gliadin-glutenin ratio at 75 per cent. of gliadin and 25 per cent. glutenin.

Gliadin constitutes the binding material of the flour and enables the dough in bread making to retain the carbonic acid gas which is

formed by the fermentation started by the addition of yeast. The yeast is used in bread making to expand the dough and to produce certain changes in the starch and proteids of the flour. The idea is to get the dough for a loaf of bread in the oven and baked before the gas has all escaped. This gives a light loaf, *i.e.*, a loaf in which the particles of dough have been held in a distended form long enough to be baked in that condition, and before the gas had all escaped and the dough had settled again into a solid mass. A gluten very rich in glutenin produces a dough which is dry and short. It does not rise easily because it cannot hold the gases, and gives after baking a compact mass. A gluten too rich in gliadin behaves well during fermentation because it is soft and yielding, but, in baking the gliadin dissolves before the baking is complete, thus allowing the gaseous products to escape and the dough to spread itself and collapse.

Quality in Wheat.—It is impossible to ascertain the amount of gluten in a sample of wheat other than by analysis, but wheats possessing the gluten of superior qualities give outward indication of the fact. The best indication is hardness or flintiness. It is due to the conditions surrounding growth. When grown in a humid climate where the rainfall is abundant, or under irrigation, the wheat is generally soft and light coloured, or starchy, and the protein content low. When grown on comparatively light, fertile, prairie soil in a short, forcing season, in a country with a comparatively light rainfall, the tendency is to produce a hard, glutinous wheat. These are the conditions under which our wheats are raised and besides this we have the additional advantage that we are farther north. It is a well-known fact that the farther north a grain can be grown the more perfect is its development.

With a short knife cut a number of kernels of wheat in two crosswise. Note the differences. Where the outside of the kernel has a hard and flinty appearance and is of a dark, amber colour, the cross section will show a clear, amber, semi-transparent colour, as against a white starchy, opaque appearance when the kernel is soft and whitish.

The cause of the semi-transparent amber colour is said to be due to the fact that the starch grains within the cells are embedded in a dense matrix of proteid material, as the albumenoid or gluten constituents are called. In the softer kernels the cells are not completely filled with reserve material, but very minute air spaces exist between the starch grains within the cells.

Pastry Flour.—The soft wheats, while not so suitable as the hard ones for the manufacture of strong bakers flour, are admirably adapted for pastry flour. As they frequently give heavier yields than the hard wheats they are quite profitable to grow. Pastry is not required to rise in the same way as bread, hence it is not necessary to have in a suitable flour for this purpose as high a percentage of gluten. Soda or baking powder does in pastry cooking what the yeast does for bread, only there is no fermentation. Baking powder could be used for bread making but we would not then have a leavened loaf and the tenacity of the dough would prevent the action of the chemicals in the powder.

Durum Flour.—With the increase in the area devoted to the growth of durum or macaroni wheats, particularly in the semi-arid portions of the United States, considerable flour from these wheats has come on the market. The wheat is very hard and requires specially constructed machinery for handling it. The flour is of good quality and strong in gluten. It is perhaps a trifle sweeter than common flour and some people prefer it. It makes a nice, rich brown crust and seems to hold the moisture for a greater length of time in the loaf than the other flour. A share of the flour is being used for the manufacture of macaroni for which it is particularly adapted.

Whole Wheat Flour.—There is perhaps no other article of food which furnishes in a more appropriate form the essential elements necessary for the nourishment of man's body. In the manufacture of fine white flour a large percentage of the gluten is taken out on account of its colour, but it is a very nutritious portion and many people prefer flour with it in. While coarse flakes of bran are to be generally avoided, yet finely ground particles are readily acted upon by the digestive fluids of the stomach. Whole wheat flour is really preferable for pie crust, plain cakes, gridale cakes, toast, puddings and gems. The nitrogen in the gluten is the great element used in the body for the repair and building up of the muscular tissues, and with the mineral matters for the nourishment and sustenance of the nervous system. Where there are growing children, anæmic persons or those leading sedentary lives whole wheat flour should be used.

Yellow berry.—Sometimes amongst hard wheat there are found kernels having a yellowish, white spot on them. These kernels are found in wheat grown on a variety of soils. They are common on land cleared from brush and small timber. Open prairie land is generally free from them. It was at one time thought to be due to some peculiarity in the brush land, because the affected grain when sown the following year on the open prairie produces all hard grain. Some seasons seem to be conducive to the production of these soft spots in the kernels, as it has been found in grain grown on the open prairie. Much of the winter wheat grown in Kansas contains yellow berries and it is common in other States. No definite solution has been offered as yet as to the cause of this spotting of the grain, but it would appear to be due in some measure to the peculiarities of the ripening period, or else to a lack of a sufficient supply of protoplasm-forming material just at the time the berry is forming. It is found more abundantly on land that is beginning to run out, i.e., has lost that superabundant supply of nitrogen peculiar to all fertile prairie soils.

4.—JUDGING WHEAT.

In judging wheat long experience has taught the miller what to look for when examining the grain; accordingly the following score card has been arranged for judging wheat entirely from the millers' standpoint:

SCORE CARD FOR COMMERCIAL WHEAT.

	Possible.	Student's score.
1. Milling value as indicated by hardness and texture. (Hard translucent grains indicate a high per cent. of gluten and a capacity for producing a large quantity of strong patent flour suitable for bread making. Opaque grain and soft, starchy appearance indicate a deficiency in gluten. Such wheats produce a flour more suitable for biscuits or pastry.).....	30	..
2. Weight per bushel.....	25	..
3. Soundness (freedom from damage by rust, frost, etc.)..	15	..
4. Colour (uniformly bright and clear, not weathered)....	10	..
5. Uniformity of size of grain and of plumpness.....	10	..
6. Freedom from weed seeds, smut and other impurities.	10	..

EXPLANATIONS OF SCORE CARD.

1. *Milling value*.—Hardness and texture are closely related and have been explained under Quality in Wheat.

2. *Weight*.—The old statement that a good wheat never has a low weight per bushel, and a poor wheat is never of a high weight, is generally true. The weight per bushel is a pretty accurate guide, other things being satisfactory. Wheat that weighs from 62 to 66 lbs. per bushel, as it does frequently, must be good wheat. It means that the berries are all well filled with good solid material.

3. *Soundness*.—Unsound grain is useless for the production of high grade flour, and must be eliminated. Sprouted, bin-burned damp or injured grain is not wanted in a good milling wheat and must be separated out, or it will produce only a low grade flour. Rust reduces the weight of the grain and darkens the end of the berry. Must also spoils it. Frost reduces the value of wheat very rapidly and renders it unfit for the production of a first class article. Besides the action of frost on the wheat before it is quite ripe, another action has been noticed of recent years. This is where an early fall of snow has taken place. It has lain long enough on the grain in the stook as it was melting to soften some of the kernels on the outside of the sheaves. When this grain is threshed it will be found that it has the appearance of having been frozen. It may have been frozen, but it is doubtful. The appearance is produced by a wrinkling of the bran due to having been wet. It has affected the bran coatings only and has not perceptibly injured the grain for milling purposes. This action has been termed a "rifle" in the bran. It has so much the appearance of having been touched with frost that it is graded that way and many a good car of wheat of superior milling quality has been lowered a few grades because of an undue proportion of these "rifled" kernels.

4. *Colour*.—The colour of wheat has a wide range. Red wheats seem to have the preference, as they seem to indicate more clearly

the desirable qualities. The white wheats, though often quite hard, generally indicate softness. The so-called red wheats are more properly called amber. This colour should be bright and not weathered or bleached in any way. The presence of "yellow berries" will lower the grade of an otherwise good sample. Many good farmers cut wheat a little on the green side, *i.e.*, just before it has quite reached the stage at which it would generally be cut, on purpose to improve the colour of the sample. Sweating in the stack is also said to improve the colour.

5. *Uniformity of the Size of Grain.*—Where the grain has to pass over a number of sets of rolls uniformity in the size of the grain is an important thing, as then the work will be evenly done and the best results obtained. The millers prefer a medium-sized berry, plump and uniform, to very large ones or a mixture of large and small.

6. *Freedom from Weed Seeds, Smut, etc.*—These impurities will not make flour and must be removed from the wheat; hence not wanted. The biggest loss farmers are sustaining to-day is occasioned by the amount of weed seeds and other dirt in their grain. Smut is also prohibitive, and smutty grain must go to the cleaning elevator to be scoured and cleaned before it is fit for use.

Section II.—OATS.

1.—CLASSIFICATION AND VARIETIES.

Next to wheat, the most important crop grown in the province is oats. It grows to such perfection that it is doubtful if there is another province in the Dominion where an average yield of 37.7 bushels per acre for a period of nine years has been obtained. This is machine measure, and as the oats weigh from 40 to 48 lbs. per bushel, the actual average yield by weight for the province is nearer



OAT HEAD representing the spreading type.

45 bushels than that given above. At the last Provincial Seed Fair the first prize grain weighed 48 lbs. to the bushel and there was not a sample on exhibition that weighed under 40 lbs. Recently before the Royal Grain Commission the chief grain inspector at Calgary made the statement under oath that 85 per cent. of the

Alberta oats he had graded would weigh over 43 lbs. to the bushel. These figures prove that Alberta oats are of exceptional quality and a request has been made for a special grade for Alberta oats weighing not less than 42 lbs. to the bushel.

The origin of the oat is doubtful. It is thought to be a native of Northern Europe or Asia and derived from a species of Tartarian oat now unknown. As a plant food it is less used than formerly but it is still largely used as a breakfast cereal. It forms the standard food for stock, particularly horses.



OAT HEAD representing the side type.

Oats do well upon a great variety of soils, and thrive best in temperate climates. They are very hardy and can be sown quite early in the spring. In a dry climate, unless there is considerable moisture in the soil, the grain is liable to grow thin with a thick husk. The awns are also inclined to grow longer. When long awns begin to develop on a cultivated variety of oats, as a general rule, it may be taken as a sign that it is running out.

The general characteristics of the oat family may be given as follows: The heads or ears form in a panicle, the branches of which

spread out widely in some varieties, forming the loose or open head, while in others they are more or less closely pressed to one side of the main axis of stem, forming the flat or side oats. The branches arise from alternate sides of the rachis. Oats differ from wheat in that the grain is attached to the branches by a flexible pedicel or stem. Each panicle contains about 75 spikelets and each spikelet has two or more flowers, the lower ones developing into the longer grain. The outer glumes are large, membranous, pointed, completely enclosing the rest of the spikelet, and are always of a pale yellow or straw colour. The flowering glumes are thick and frequently have a bent and twisted awn which is absent in the finer varieties. The colour may be white, yellow, dun, brown, or black. The culms or stalks are larger in diameter and slightly softer than those of wheat.



STRUCTURE OF THE OAT SPIKELET, showing: A—Flower in bloom; B—a single spikelet; C—Spikelet dissected.

Classification.—The following grouping of the various varieties of oats shows their relation to one another:

ORDER GRAMINEAE, GENUS AVENA.

Species:—

1. *Avena fatua* (Wild oat), slender stems, large open spreading panicle, spikelets generally three flowered, the flowering glume having a strong, bent twisted awn. The rachilla and base of the flowering glume are covered with long brownish hairs, a too common weed, though used in some places for fodder purposes.
2. *Avena strigosa* (Bristle pointed oat), often confused with the wild oat, but it has one-sided panicles and fewer branches.

The rachilla and base of the flowering glume are smooth—was formerly cultivated but now abandoned for superior varieties.

3. *Avena brevis* (Short oat), a species with a thin grass like stem and bulky crop of leaves. Sometimes grown for fodder purposes at high altitudes where other oats fail.
4. *Avena sterilis* (Animated oats). So called because the awn is like that of the wild oat and twists when moistened. Grown in gardens as a curiosity and often confounded with wild oats.
5. *Avena sativa* (Common cultivated oat), open spreading panicles.
6. *Avena orientalis* (Tartarian oat), with contracted one-sided panicles, sometimes called "side oats," or "branch oats."
7. *Avena nuda*.—A hullless type found in both the foregoing groups.

Oats may also be divided according to the colour of the hull into white, gray, red and black oats.

Varieties.—Among the cultivated varieties of oats there is a considerable diversity in—

1. The length of straw;
2. The period of ripening;
3. The colour and thickness of the husk or flowering glume;
4. The form of the grain;
5. The tendency to shed when ripe.

Varieties of oats commonly grown in Alberta:

Long Type.—Banner, Dodd White, Swedish Milling;

Short Type.—Tartar King, Storm King;

Medium Type.—Waverly, Sensation.

RESULTS OF VARIETY TESTS AT BRANDON AND INDIAN HEAD FARMS.

1905.—OATS.

BRANDON	Days matu ring.	Yield per acre.		INDIAN HEAD	Days matu ring.	Yield per acre.	
		Bus.	Lbs.			Bus.	Lbs.
Golden Giant.....	125	135	10	Goldfinder.....	122	117	22
Improved American....	122	134	04	Pioneer.....	124	112	32
Goldfinder.....	123	132	12	Siberian.....	120	111	26
Golden Beauty.....	123	129	14	Joanette.....	124	111	26
Golden Fleece.....	123	125	10	Golden Tartarian.....	122	111	06
Banner.....	123	122	12	Twentieth Century....	116	110	20
Bavarian.....	123	121	26	Columbus.....	121	110	20
Abundance.....	120	121	06	Golden Beauty.....	122	110	20
Pioneer.....	117	120	20	American Triumph.....	119	110	..
Siberian.....	124	118	28	Tartar King.....	119	110	..

1906.

Improved American....	106	110	20	Banner.....	116	128	28
Buckbee's Illinois....	110	99	24	Goldfinder.....	119	119	14
Golden Giant.....	114	99	14	Golden Beauty.....	116	114	04
Abundance.....	109	96	06	Twentieth Century....	117	103	18
Siberian.....	110	99	24	Golden Giant.....	121	112	12
Banner.....	110	114	04	Irish Victor.....	117	112	12
Wide Awake.....	110	97	22	Danish Island.....	114	102	32
Danish Island.....	110	105	10	Columbus.....	118	111	26
Goldfinder.....	113	97	02	Bavarian.....	116	124	04
Twentieth Century....	111	102	32	Holstein Prolife.....	115	111	06

1907.

Danish Island.....	109	130	..	Sensation.....	134	127	32
Banner.....	107	128	28	Columbus.....	124	127	22
Goldfinder.....	111	127	32	Swedish Select.....	129	127	22
Joanette.....	111	127	02	Danish Island.....	122	123	08
White Giant.....	111	126	26	Banner.....	127	122	32
Golden Giant.....	111	126	06	Improved Ligowo....	124	122	02
Improved American....	108	125	..	Golden Beauty.....	124	121	06
Lincoln.....	109	122	02	Irish Victor.....	130	119	14
Columbus.....	110	122	02	Bavarian.....	127	117	22
Kendall Black.....	111	122	02	Improved American....	132	117	02

2.—GERMINATION AND STRUCTURE.

Soak a few kernels in the same way as was done with wheat. Examine; note that the flowering glume and palet is not firmly attached to the kernel but are free from it though closely surrounded by it. On germination the plumule behaves in the same way as in barley-growing under the flowering glumes, or the hull or husk, as they are popularly called, and emerging at the opposite end to that at which the roots appear. The number of roots springing from the embryo is three.

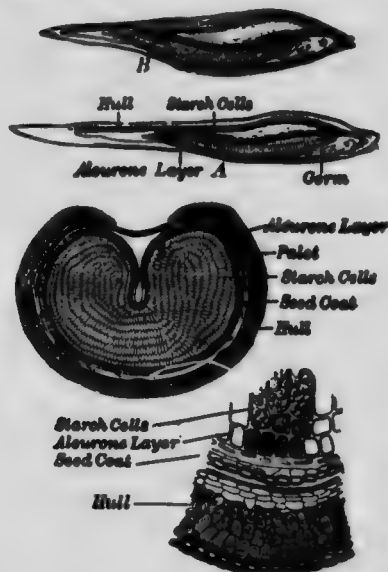
The accompanying illustrations show the structure of an oat grain of the thick short and long slender types.

3.—MILLING QUALITIES.

The following notes are for milling oats rather than for those intended for feed. A good deal of what is said, however, is equally applicable to feed oats, for must, weed seeds, and unsound grain,

all render the grain less valuable for feed. Farmers make a great mistake in not cleaning the oats they feed their horses, as in this way weed seeds are spread over the farm. In this connection attention may be called to the practice of allowing the winter travel to make short cuts across the land. This, while an accommodation to the public, is a very sure way of introducing foul weed seeds. The droppings of horses contain many undestroyed weed seeds, and others are shaken off many a conveyance as it passes over the land.

In the manufacture of oatmeal the grain is thoroughly dried in kilns, the ends of the grains are clipped off, and they are passed through a machine which takes off the hull. The hulled grain is then ready for the rolls and final manufacture into oatmeal.



STRUCTURE OF THE OAT GRAIN. The figures A and B represent the short, thick and the long slender types, cut through at the crease. The two lower sections show cross sections.

This brief description serves to bring out a few essentials that a good milling oat must possess.

Ripeness.—Oats cannot be too ripe for the miller. This means full development of the starch cells and a high quality of meal. Consequently while the grain should be allowed to get as ripe as possible, yet it should be cut before there is danger from shelling. If cut too green the porridge will be pasty.

Freedom from Broken Grain.—Carelessness in threshing causes a considerable loss. Broken grains reduce the uniformity of the flake in the meal, consequently they are not wanted. Care should be taken to set the concave of the separator so as to reduce to a minimum, consistent with other things, the number of broken and hulled grains.

Plumpness.—This is of the first essential whether the oat be of the short thick kind or of the longer variety. The percentage of hull to kernel is less in the plump grains.

Purity.—For milling purposes the grain must be pure, i.e., there should be nothing but oats. It should be free from other grain, weed seeds, etc. Then the oats should all be of the same type, i.e., either short or long, but no mixture of the two types. This is necessary, otherwise when passing through the clipping machine there will be undue waste. When the machine is set to clip short oats too much will be cut off the long ones; or if the machine is set to clip the long oats the short fellows run through unclipped. The result is that the hull is not removed in the huller and passes into the oatmeal, where it is a decided objection.

Soundness.—Decayed and unsound kernels are an objection, because they spoil the quality of the resultant meal. Frozen oats are also unfit for milling, because the germ turns black. Rust causes the grain to shrivel and discolours the end, spoiling the colour of the oatmeal.

Mustiness.—Must spoils the grain for milling purposes. This is almost equally true for feeding purposes.

4.—JUDGING OATS.

The following score card has been devised for judging oats for milling purposes, and though not quite suitable for judging feed oats will answer fairly well.

SCORE CARD FOR COMMERCIAL OATS.

	Possible	Student's score
1. Weight per bushel	30	..
2. Soundness: Free from damage by rust, frost, etc.	15	..
3. Hulls thin and light in proportion to kernel	15	..
4. Colour: uniformly light, not weathered	10	..
5. Uniformity in size of grain	10	..
6. Freedom from smut and must	10	..
7. Freedom from weed seeds and other grains	10	..

EXPLANATION OF SCORE CARD.

1. *Weight per Bushel.*—Alberta is noted for the quality of her oats and is prepared to fill a grade calling for a weight of 42 lbs. per bushel. The official weight is only 38 lbs. per bushel, while many samples will weigh 48 lbs. Weight is essential as it reduces the percentage of hull. There is a great difference in varieties, some having long awns and others coarse hulls, which do not allow the grain to pack together well. In oats of a similar character the weight forms a fair basis of judging. Cut one point for every pound the grain is under 42 lbs. to the bushel.

2. *Soundness.*—Sprouted, decayed, frozen, broken or rusted grains are of no use for milling purposes, and if present only spoil the oatmeal.

3. *Hulls thin and light in proportion to Kernel.*—If through poor soil, unfavourable climatic conditions, or attacks of insects, the full development of starch does not take place the percentage of hull will be very high in proportion to the amount of the kernel. The percentage of hull varies all the way from 25 to 35 per cent. A fair average milling oat will have about 30 per cent. hull, while superior milling oats will drop below this. As the hull is all waste (except as the miller can successfully grind into oat chop) its thickness or thinness is an important item. Millers prefer the long type of oats, because they make a better shape of flake in the meal,—longer and not so broad. Then, too, the long type of oat has usually a thinner hull. It is easily seen that there is more waste in the oat with a thick than a thin hull, as there is a less proportion of kernel to the total weight.

4. *Colour.*—While only of minor importance to the feeder, these points are of considerable value to the miller.

5. *Uniformity in Size of Grain.*—The importance of this has already been touched upon. Uniformity in size prevents loss in clipping the ends off the grains. Twin oats or bosom oats are an objection.

6. *Freedom from Smut and Rust.*—Neither are of any use in oatmeal. They spoil the grain for milling purposes and are bad for feed also.

7. *Freedom from Weed Seeds and Other Grains.*—The amount of these in a sample of milling oats represent just that amount of waste which must be cleaned out before the oats can be used for the manufacture of oatmeal. The miller is very particular to have his oats free from barley. It is very difficult to take the hulls off barley, and in many cases where hulls are found in the rolled oats they are barley hulls,—not oat hulls. Another objection to the presence of barley is that it makes the rolled oats pasty and gives the porridge a bad flavour as well.

Section 3—BARLEY.

I.—CLASSIFICATION AND VARIETIES.

Barley is the third and most important grain grown in Alberta. It grows wild in Western Asia and consequently this is regarded as its original home. Its cultivation dates back a long way, having been grown in Ancient Egypt (Ex. 9, 31) and by the Greeks and Romans, while the Chinese claim to have grown it 2000 B.C. It has also been found in the lake dwellings in Switzerland in deposits belonging to the Stone Age. It is adapted to cultivation in both warm and cold climates, and perhaps has a wider range of distribution than any other cereal. It succeeds well throughout the whole of the temperate zone and a considerable portion of the tropics. In the Himalayas in India good crops are obtained at an elevation of 14,000 feet above the sea, while in Chili and Switzerland it produces profitable crops at an elevation of 5,000 feet. Barley is used for making bread, but is darker in colour than wheat bread and not so nutritious. It does not contain the gluten of wheat flour, though it is rich in other proteids. It is used for soups as "pot" and "pearl" barley and in infants' food. Its great use other than as a food for stock is for malting purposes.



BARLEY FLOWER IN BLOOM.



SPIKELET OF BARLEY.

The description of barley is as follows: Heads compact, awns close and numerous; a few barren spikelets at base; three spikelets at joint, spikelets single; flowered, three at each joint; outer glumes awl shaped and 6 at each joint, 2 for each seed; flowering glumes closely to the seed; flowering glume prolonged into a stiff beard with barbed edges forming the awn.

In two-rowed barley we have the same number of spikelets at a joint but the outer ones are rudimentary. In the green stage

we have stamens but no pistil. Seeds of two-rowed barley are more uniform and also germinate more uniformly, and therefore it is generally preferred for malting purposes. In Western Canada, however, it is found that the two-rowed varieties are not so hardy and later in maturing than the six-rowed ones, thus more liable to be caught by frost.

Classification.—Barley belongs to the genus *Hordium* of the order *Gramineae*, or the *Grass* family. Owing to long cultivation there are many varieties, and the following classification gives some idea of their relation to each other:

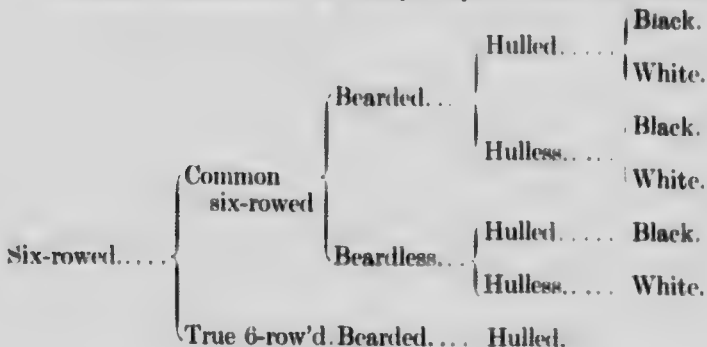
ORDER GRAMINEAE, GENUS HORDIUM.

Species:—

Sativum.—All of our cultivated barleys are included under the general name *Hordium sativum*, and are supposed to have originated from the wild species *Hordium spontaneum*, which was two-rowed. The cultivated varieties may be popularly divided as follows:

1. *Hordium vulgare* (Common six-rowed); also called Bere; Bigg; and sometimes four-rowed barley. Bere is very hardy and particularly suitable for northern Europe on account of the rapidity with which it grows. Not now much used for malting.
2. *Hordium coeleste* (Naked barley). The berry is free from the glumes as in wheat.
3. *Hordium trifurcatum* (Beardless six-rowed); also has berry free from glumes like wheat; is sometimes called Nepal wheat.
4. *Hordium hexastichon* (True six-rowed). More commonly grown in America for malting purposes than the two-rowed. Western Canadian brewers prefer the six-rowed varieties.
5. *Hordium distichon*.—a. (*erectum*—Erect two-rowed). Up-standing varieties as the Goldthorpe, fairly stiff straw and not liable to lodge.
b. (*Nodans*.—Nodding two-rowed). Ears when ripe bend over, as seen in Chevalier barley.

Another classification of barley may be made as follows:



Two-rowed... { Erect Heads. Bearded... Hulled.
Nodding hds. Bearded... Hulless.

Varieties.—Those commonly grown in Alberta are:

Six-rowed.—Mensury, Odessa, Common, Oderbrucher.

Two-rowed.—Chevalier.

In most countries of the world the two-rowed varieties are preferred for malting purposes, but in Western Canada the six-rowed varieties are used entirely. The reason for this is that the two-rowed varieties are not so hardy and consequently will not stand as much frost as the six-rowed. Again it takes about ten days longer for the two-rowed varieties to mature, and therefore they are more liable to be caught with early frost.

RESULTS OF VARIETY TESTS AT BRANDON AND INDIAN HEAD FARMS.

1905.—BARLEY.—SIX-ROWED.

BRANDON.	Days matu- ring	Yield. per acre.		INDIAN HEAD.	Days matu- ring	Yield per acre	
		Bus.	Lbs.			Bus.	Lbs.
Mansfield.....	94	77	24	Stella.....	108	82	44
Mensury.....	92	75	20	Nugent.....	108	78	36
Odessa.....	93	68	16	Claude.....	107	74	08

TWO-ROWED.

Gordon.....	97	67	44	Beaver.....	107	75	..
Jarvis.....	97	63	36	Invincible.....	110	74	28
Harvey.....	94	63	16	Gordon.....	108	64	28
French Chevalier.....	98	62	04	Standwell.....	111	62	04
Danish Chevalier.....	98	60	04	Swedish Chevalier.....	111	59	28

1906.—SIX-ROWED.

Mensury.....	91	61	12	Odessa.....	101	65	40
Yale.....	90	60	10	Claude.....	103	46	12
Mansfield.....	91	47	44	Nugent.....	106	49	28

TWO-ROWED.

Gordon.....	93	59	18	Invincible.....	109	52	24
Jarvis.....	91	66	22	Standwell.....	108	52	24
Harvey.....	91	53	26	Danish Chevalier.....	111	60	..
Clifford.....	92	60	30	Canadian Thorpe.....	106	48	16
Durham.....	92	49	38	Gordon.....	102	52	24

1907.—SIX-ROWED.

Oderbruch.....	88	81	12	Blue Longhead.....	105	86	02
Claude.....	88	75	20	Mansfield.....	106	72	14
Odessa.....	87	71	12	Oderbruch.....	108	68	26

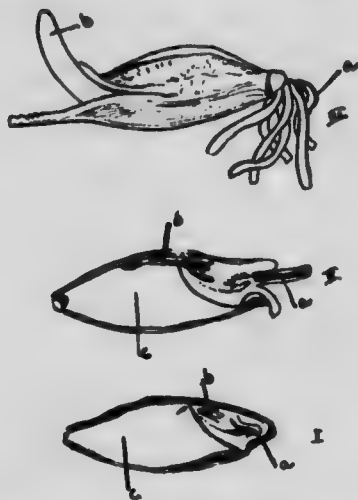
TWO-ROWED.

Standwell.....	97	79	08	Jarvis.....	111	61	02
Swedish Chevalier.....	95	78	36	Standwell.....	111	59	08
Jarvis.....	94	72	04	Danish Chevalier.....	116	58	16
Canadian Thorpe.....	94	71	42	Logan.....	109	56	12
Danish Chevalier.....	94	70	20	Swedish Chevalier.....	116	54	28

2.—GERMINATION AND STRUCTURE.

Soak a few grains of barley in the same way as was done with wheat. Examine. It will be found that the plumule instead of coming away at the same end as the roots grows under the enclosing flowering glume and palet to the opposite end, where it emerges some time after the roots have made their appearance. Note that the number of roots visible in a barley grain is five or six.

The accompanying illustrations show the various stages of development in the growth of a grain of barley. Note that the young plant has in it at a very early stage all the joints or nodes of the mature plant and that the growth is merely a lengthening out of the various sections.



I. Longitudinal section of a grain of barley showing embryo.
(a) the roots; (b) the plumule; (c) the body of the grain or endosperm.

II. The same after germination has begun. The roots have started at a and the plumule at b; still inside flowering glume.

III. A later stage showing several roots at a and the plumule outside the glume at b.

3.—BREWING QUALITIES.

Aside from its value for feed the great use to which barley is put is the making of malt for beer, porter, ale and spirits. To understand what is required of a good barley for malting purposes it is necessary to look into the process the grain undergoes. Malting is really a forced or artificial germination and growth of the seed. The grain is supplied with sufficient moisture and heat to cause it to swell and sprout. Growth is allowed to continue until the sprouts attain a length equal to about that of the grain when further growth is checked and the grain dried. The sprouts are then rubbed off and sold for feed as "malt sprouts" or "malt combs." When germination starts the starchy contents of the kernel are acted upon

by a diastase which converts the unfermentable starch into soluble sugar and dextrin. The insoluble albuminoids are acted upon by a ferment and converted into soluble ones. Barley is more suitable for malting purposes than wheat, corn or rye, because the barley malt contains a larger percentage of certain ferments, classified under the general name of "diastase" than that made from other grains and which are useful in malting.

Having converted the grain from insoluble to soluble forms it is possible then through the use of ferments and various processes to further change the sugar and dextrin into beer, ale and porter. The insoluble portion of the grain left after the operations are over is called "brewers' grains," and is used extensively for feeding, especially fattening steers and milch cows. It is claimed that it is well adapted for the latter purpose, as it contains a high percentage of proteid compounds in a soluble form. If spirits are to be produced from the malt, distillation is one of the processes through which the malt passes in order to obtain the spirit. The refuse after distillation is called "distillery slop," and is used for fattening steers.



- I. More advanced stage of B, showing *b* developed into a shoot.
- II. The node at *N* again enlarged, showing how the spaces between the nodes are lengthening out.

Characters of good Malting Barley.—A high starch content is the first essential and the best samples of malting barley containing from 60 to 65 per cent. of starch. The amount of proteids should be as low as possible as a high percentage gives turbid worts and the keeping quality of the resultant beer is reduced. Old country brewers prefer a low percentage of proteids—7 to 9 per cent.,—while American brewers handle successfully barley containing as high as 12 to 14 per cent.

The amount of water in the grain is of some importance. The drier the grain the more quickly and evenly will it germinate as a

rule. The higher the water content the more liable is the grain to spoil in keeping and to lose in germinating capacity. The amount of water present in the grain depends upon the stage of ripeness reached when the grain was cut, the climate in which grown, the method of harvesting, and the subsequent sweating in the stack.

It is always desirable to have barley as ripe as possible, for the reason that the full starch content is then obtained and the germ is fully developed. The latter means more even germination. The power to germinate quickly and evenly is a very important factor in producing malt.

The absence of broken, cracked, bruised and skinned grains is very essential, as these will not germinate and only tend to develop mould. Great care should be taken in threshing barley to have the concave of the threshing machine set as low as possible consistent with clean threshing. It is better to leave a little awn or stem on the grain than to set the machine so close that the ends will be too



- A. Young barley plant showing the first roots. (c) Shows first sheathing leaf; (d) blade of first green leaf.
 B. Later stage of A. a roots; n first node or joint of stem just below the ground.
 C. Longitudinal section of B at n showing at a the terminal bud and at b a first tiller starting out

closely nipped off, or the grain broken or cracked. Much loss can be occasioned by neglecting to watch this particular point, as these grains will not germinate owing to the embryo or germ being injured. Barley for malting should not be fed too rapidly into a thresher, but steadily and evenly at a moderate rate. Attention to these points will greatly improve the barley for malting purposes.

As the object of the brewer is to produce as pale or clear a beer as possible, the colour of the barley is an important factor. It

should be a pale yellow, or a pale clean straw colour and uniform all over the grain. Consequently care must be taken in harvesting and handling the crop to preserve the colour. While it is desirable to have the barley as ripe as possible, yet as the crop approaches full maturity heavy dews have a tendency to darken the colour. Rain always does so, consequently great care should be taken to have the grain stacked as quickly as possible after it is cured. If stacked too soon the colour may be spoiled by over-sweating or heating in the stack. Bleached or discoloured grains are considered a sure sign of inferior quality.

Black barleys when fully matured are usually quite blue black in colour, shading to various degrees of blue, purple and almost black.

4.—JUDGING BARLEY.

SCORE CARD FOR COMMERCIAL BARLEY.

	Possible	Student's score.
1. Uniformity of colour.....	20	..
2. Uniformity of texture.....	20	..
3. Uniformity in size of grain.....	10	..
4. Weight per bushel.....	10	..
5. Freedom from injury by threshing.....	15	..
6. Freedom from sprouted, bin-burned, decay, etc.....	15	..
7. Absence of foreign matter.....	10	..

EXPLANATIONS OF SCORE CARD.

The brewers' standpoint is the only one that governs in judging barley, because it is the brewing qualities that determine market values.

1. *Uniformity of Colour.*—As mentioned above this is very essential, as it indicates so much as to the quality of the grain. Examine a sample for colour. Separate out in two or three parts the grains of similar colour, or rather discolouring. Let the divided part having the greatest number of grains be accepted, as the colour for the sample under examination, and in scoring deduct points for the other portions according to the amount of discolouring.

2. *Uniformity of Texture.*—As in wheat, there is great difference in the texture of different samples of barley. Some are hard, horny or flinty, and others more mealy. For brewing purposes it is important that there be uniformity throughout the sample. Grains with thick heavy "skins" will not germinate evenly with those that are thin. Neither will there be even germination of those that are hard and flinty in nature as compared with those that are softer or more mealy. If the germination is not even, those germinating last will not have reached the same stage of development as those first started, and consequently the action of the diastase in converting the starchy compounds into sugar, which takes place during germination, will not have been as fully completed, and hence a loss

will occur. Brewers state that the two-rowed varieties take about twelve hours longer to malt than the six-rowed ones, hence there is a decided objection to the mixing of the two varieties.

3. *Uniformity in Size*—This is important for the reasons just given above. Two-rowed barley is usually short and plump while the six-rowed is long and narrow. They should never be mixed, therefore, as they will not germinate evenly.

4. *Weight per Bushel*.—Brewers like the grain to weigh well, other things being equal. As a rule a heavy-weight barley has a smaller percentage of hull and a higher percentage of starch than a light-weight one. Other considerations come in, however, which might make it possible for quite a light-weight barley to outsell a much heavier one. In scoring cut one point for each pound below 48 lbs. per bushel.

5. *Freedom from Injury by Threshing*.—The importance of this is best illustrated by the number of points given in the score. As mentioned above, split, cracked, or skinned grains absorb moisture and do not malt evenly with uninjured grains. Too "close" threshing clips the awns off too short and this causes similar damage by letting the moisture in.

6. *Freedom from Sprouted, Bin-burned, Decay, etc.*—Often excessive moisture causes grains to sprout, and such grain is absolutely useless for malting purposes. The same applies to grain that has been overheated in the bin. The germinating power has been destroyed and the grain is useless for malting purposes. The same is true of decayed grains.

7. *Absence of Foreign Matter*.—The only thing in a sample of grain for malting purposes that is of any use is the barley in that sample. All else is foreign matter and useless.

It is found that semi-arid countries produce a barley much drier in its nature than those possessing abundance of rainfall. For this reason, other things being equal, there is no reason why Alberta should not grow an excellent quality of barley, provided that the necessary care is taken in growing and harvesting the grain.

Section IV.—GRAIN FOR SEED.

In the production of good grain there is no more important factor than the kind and quality of the seed used. "Like begets like" is a law that relates as truly to the cereal crops as to the breeds of live stock, to which it was first applied. It is obvious, therefore, that to grow good milling wheat or oats we must sow the same, for "whatsoever a man soweth that shall he also reap." The seed is important not only in thus transmitting the characteristics of the type from generation to generation, but also in that it is the source of life and the supply of food for the young plant during the first stages of its life. Thus a weak, shrunken seed possesses less vitality and nourishment and gives the plant a poorer start.

1.—JUDGING SEED GRAIN.

In order to make a careful examination of any grain it is always well to follow a systematic plan in judging. This can best be done by the use of a score card. The following cards used at seed fairs have been found to answer very well for the leading grains. Full explanations are given with each.

WHEAT.

SCORE CARD FOR SEED WHEAT.

(Issued by Seed Branch, Dominion Department of Agriculture.)

	Possible	Student's score
PURITY.		
(a) Free from weed seeds.....	20	..
(b) Free from other kinds of grain and from useless impurities.....	8	..
(c) Pure as to variety as near as can be determined.....	10	..
(d) Free from smut.....	12	..
QUALITY OF GRAIN.		
(a) Grain sound, well ripened, free from damage by rust, frost, etc., and apparently of strong vitality.....	13	..
(b) Grains uniformly plump and relatively large for the variety, weighing well per measured bushel..... lbs. weight.....	18	..
(c) Grain of good milling value, considering the purpose for which it is intended. Hard, translucent grains indicate a high per cent of gluten and a capacity for producing a large quantity of strong patent flour suitable for bread-making. Opaque grains of a soft, starchy appearance indicate a deficiency in gluten. Such wheats produce a flour more suitable for biscuits or pastry.....	14 5	..
(d) Colour uniformly bright and clear, not weathered....	5	..
Total	100	...

EXPLANATIONS OF THE SCORE CARD.

PURITY.

(a) *Free from Weed Seeds.*—Probably more new weeds are brought into a district through dirty seed grain than in any other way. This point is, therefore, much more important in judging for seed than in commercial grading. In grading, a seed of wild oats is no more harm than a piece of dirt the same size and weight. In judging for seed, a weed seed has the same objection, viz.: it decreases the proportion of pure grain in the sample, but it also has a far much greater fault of being able to grow when sown and thus reproduce and spread the weed of which it is the seed. Therefore a great deal of stress is laid on seed grain being free from the seeds of noxious weeds.

Wild oats is the most objectional of impurities in seed grain. It is a very bad weed, and the seed is almost unremovable from seed grain. The presence of wild oats in a sample of seed grain is, therefore, sufficient reason to disqualify it at any seed fair, or to prevent any wise farmer from using it for seed purposes. There are three distinguishing marks by which wild oats may be identified. Colour is not one of the three. Cultivated oats may be of several other colours, as already noted and wild oats may be black or white or gray.

The nature of the *awn* is a distinguishing mark. The cultivated oat may have an awn, but it is small and straight, or nearly so, not twisted. The wild oat awn is long and has a sharp bend or elbow, giving it the general appearance of a grasshopper's leg. The stouter half of the awn is tightly twisted like a rope: this when moistened unwinds, causing the oat to squirm about or even to move a perceptible distance.

A further characteristic of the wild oat is its *hairiness*. In its natural condition it always has a considerable amount of stiff hair on the bosom and around the point of attachment to the stem. These two characteristics, shape of awn and hairiness, always occur in the wild oat in its natural state, but they may be entirely removed by threshing or handling.

The third characteristic is, therefore, the final and only sure test; it is the *peculiar shape of the larger end of the grain*. This is the end by which the seed was attached to the stem; a scar remains. In the cultivated oat this scar is small, and right at the end of the grain, so that the oat comes to a point. In the wild oat the scar is large, with a horseshoe-shaped ridge around it and is set partly on the end and partly on the bosom side of the grain; the whole giving the end of the oat much the appearance of a fish's mouth.

The seeds of the weeds of the mustard family, such as stinkweed, ball mustard, wild mustard, hare's ear mustard, tumbling mustard and false flax, are very objectionable in seed grain. They are not as serious a fault as wild oats, however, as it is possible to remove them. There is always the danger of some of the seeds remaining in the grain even if well fanned. As they are very noxious weeds, their presence in seed grain is, therefore, a serious fault.



1. Form of Wild Oat (*Avena fatua*) (enlarged) as it usually occurs as an impurity in grain, the awn and hairy growth being broken off during the process of threshing.
 2. Form of Wild Oat (enlarged) as it occurs in nature.
 3. Form of Wild Oat (natural size).
 - 4 and 5. Forms of Cultivated Oat (*Avena sativa*) (enlarged).
 6. Form of the cultivated oat (Natural size).
- A. Point of attachment of "bosom" oat. This characteristic in the Wild Oat is seldom present in the "bosom" grain.
- B. Note the peculiar sucker mouth, or horseshoe-shaped bend.

The seeds of the cockle and great rag weed, or other seeds hard to remove should be considered a disqualification for seed grain. Wild buckwheat is the most common impurity in Alberta seed grain. While it is not generally considered a bad weed, it is becoming a great nuisance. The seed is hard to remove, and is, therefore, when present in quantity, a serious fault. It is a safe rule to go on, that any foreign seed in seed grain is a most undesirable impurity.

(b) *Free from other kinds of Grain.*—Wheat is used to make flour; oats and barley are entirely unsuited for that purpose. Their presence, therefore, is a dead loss in a sample of wheat for milling purposes. They are even more undesirable in seed grain because by sowing them we are perpetuating and increasing an objectionable mixture. They are extremely difficult to remove, and this fact increases their undesirability.

(c) *Pure as to Variety.*—As discussed in the chapter under variety, there are certain varieties of wheat eminently suited to certain purposes. The desirability of having these best varieties pure is quite evident. For instance a mixture of Alberta Red and white winter wheat is valuable for neither bread making nor biscuit making. Experience and experiments have shown that there is a great deal of difference in the utility of different varieties as regards productiveness, earliness, hardness, etc. When we choose a good variety it is very important that it be free from an admixture of these less useful varieties. It is impossible to separate a mixture of different varieties; this fact greatly adds to its undesirability for seed purposes. It is often impossible to distinguish one variety from another in a threshed sample of grain, but in as far as it is possible to determine wheat containing a mixture of varieties should be discriminated against for seed purposes.

(d) *Free from Smut.*—*Stinking smut* in wheat is a most prolific cause of loss to the Alberta farmer. It is one of the most serious objections in milling wheat and is much more objectionable in seed wheat. Through the seed is the only possible way for smut to continue from year to year. Consequently if it were possible to sow nothing but smut-free seed, there would be no more smut. On account of the small size of the smut spore, the disease may be caused by an amount of smut on the seed that would not be considered as an objection in milling wheat. The appearance of the smut ball, and of smut-tagged wheat, is well known and need not be described. The surest way to distinguish in a sample that has very little smut in it is by the smell.

Loose smut in wheat is not very common, and evidence of it rarely seen in seed grain.

QUALITY OF GRAIN.

(a) *Grain sound, well ripened.*—Good seed wheat should be undamaged by frost, by exposure to rain, by lodging, by must or mould, or by other natural causes. A frost that comes after the wheat is ripe and ruffles the bran is not nearly as objectionable as an earlier one that discolours the whole grain or causes it to shrink. Good seed grain should be mature. When cut green it has not the strength or vitality of well ripened wheat.

(b) *Grains uniformly plump.*—Plumpness is usually accompanied by vigour, strength and productiveness; it is the principal indication in threshed grain of these qualities. Plumpness and uniformity are requisites in the highest grades of milling wheats, and are, therefore, desired in seed grain to be used in producing milling wheat. A

large plump seed of wheat gives the young plant more strength to start its growth and more nourishment to carry it along until it can nourish itself from the soil. In judging for size the variety must be considered, as some of the best varieties, Red Fife for instance, are small kernelled.

(c) *Grain of Good Milling Value.*—The milling quality of wheat has already been treated upon in another chapter. In order to grow good milling wheat the seed sown should possess the same characteristics.

(d) *Colour, uniformity, bright, clear.*—The colour, while a consideration, is relatively of less importance in seed wheat than in milling wheat, hence the score is small.

OATS.

SCORE CARD FOR SEED OATS.

(Issued by Seed Branch, Dominion Department of Agriculture.)

PURITY.	Possible	Student's score
(a) Free from weed seeds	25	..
(b) Free from other kinds of grain and from useless impurities	10	..
(c) Pure as to variety, as near as can be determined	10	..
(d) Free from evidence of smut or rust	5	..
QUALITY OF GRAIN		
(a) Grain sound, well ripened, free from damage by rust, frost, etc., and apparently of strong vitality	20	..
(b) Grains uniformly plump and relatively large for the variety, weighing well per measured bushel	18	..
(c) Hulls thin and light in proportion to size of kernel ..	7	..
(d) Colour uniformly bright, not weathered	5	..
Total	100	..

EXPLANATIONS OF SCORE CARD.

PURITY.

(a) *Free from weed seeds.*—See under wheat.

(b) *Free from other kinds of grain.*—See under wheat.

(c) *Pure as to variety.*—This point is not as important as under wheat, in so far as usefulness of the different varieties for milling is concerned. There is less difference in the varieties of oats and many that bear different names are really the same. The remarks under wheat in regard to the different value of different varieties, through productiveness, earliness, hardiness, etc., apply equally well to oats.

(d) *Free from evidence of smut or rust.*—Smut in oats is a different kind from the stinking smut of wheat; it is, however, the same as the more uncommon kind in wheat, the loose smut. It is the cause of a large amount of loss in oats, and is propagated solely through the

seed. It has no characteristic smell, and can only be discovered in seed oats by sight. It usually appears in dark, unshapely powdery masses, looking very much like dry black muck. It does not blacken the seed like the stinking smut and is very hard to discover on the seeds of oats.

QUALITY.

(a) *Grain sound, well ripened.*—Good seed oats should be undamaged by frost, by exposure to rain, by lodging, by must or mould, or by other natural causes. Oats are extremely susceptible to damage by frost. The damage may be apparent, or it may not. It is impossible to tell positively by the appearance. This question is treated in another chapter. Good seed oats should be mature. When cut green it has not the strength and vitality of well ripened grain.

(b) *Grains uniformly plump.*—See under wheat.

(c) *Hulls thin and light.*—The hull in oats is valueless; it contains less nutriment than straw. Different kinds of oats vary greatly in the proportion of hull to kernel. An oat with a thin, light hull is much more valuable for either milling or feed than one with a heavy hull. To determine the proportion, remove the hull from a few grains and compare.

(d) *Colour uniformly bright, not weathered.*—See under wheat.

BARLEY.

SCORE CARD FOR SEED BARLEY.

(Issued by Seed Branch, Dominion Department of Agriculture)

PURITY	Possible	Student's score
(a) Free from weed seeds.....	25	..
(b) Free from other kinds of grain and from useless impurities.....	10	..
(c) Pure as to variety, as near as can be determined....	10	..
(b) Free from evidence of rust or smut.....	5	..
QUALITY OF GRAIN.		
(a) Grain sound, well ripened, free from damage by rust, frost, etc., and apparently of strong vitality.....	22	..
(b) Grains uniformly plump and relatively large for the variety, weighing well per measured bushel.... lbs. weight.....	20	..
(c) Colour uniformly bright, not weathered.....	8	..
Total.....	100	..

EXPLANATIONS OF SCORE CARD.

PURITY.

(a) *Free from weed seeds.*—See under wheat.

(b) *Free from other kinds of grain.*—See under wheat.

(c) *Pure as to variety.*—See under oats.

(d) *Free from smut.*—The smut in barley is horse smut as in oats. See under oats.

QUALITY.

(a) *Grain sound, well ripened.*—See under oats.

(b) *Grains uniformly plump.*—See under wheat.

(c) *Colour uniformly bright, not weathered.*—See chapter on brewing qualities of barley.

2.—VITALITY OF SEED GRAIN.

A very important consideration in judging or buying seed grain, and one that cannot satisfactorily be judged from outward appearance, is the ability of the seed to germinate and grow. Sometimes really good grain, so far as appearance reveals, is found to be quite infertile. The only satisfactory way to know the truth is to make a



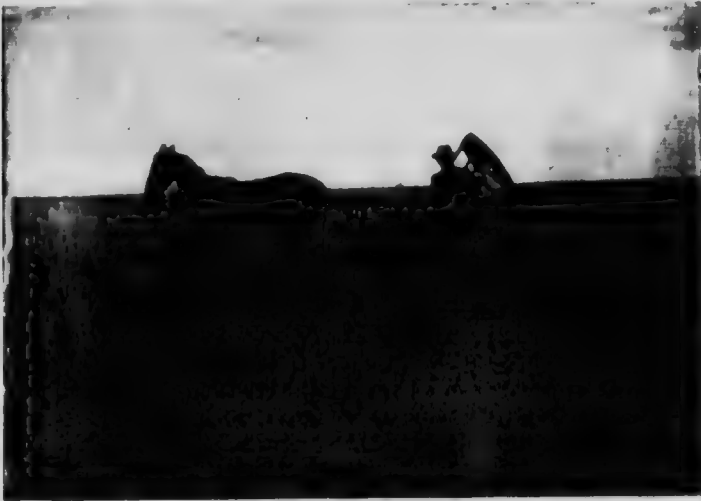
WINTER WHEAT SEEDED AT THE RATE OF 60 LBS. TO THE ACRE.

germination test. Such a test may be made by counting out an exact number, say 100, of average seeds, and planting them in a box of soil. When counting the grains they should be taken just as they come, any selection of the best kernels makes an unfair test. The seeds should be planted separately. Throwing an uncounted handful into a dish of soil is no real test. If 25% grows the little shoots make quite a show of growth, and one is led into thinking it a good test when it is really very poor. Each seed should be put in separately. The best way is to make 10 lines each way across the box; this makes 100 points at which the lines cross. Plant a seed at each

of these points and you have 100 seeds planted in squares. The result of the test can then be ascertained accurately and quickly. A quicker, easier test is to put the 100 seeds between two pieces of blotting paper, or flannel, on a plate. These must be kept wet, not flooded or allowed to dry out, but just moderately moist. In either test the temperature of a comfortable living room is the proper temperature. The soil test is the best test, in that it shows the relative strength of the seed, as well as the actual ability to germinate; there is also less danger of the seeds being allowed to dry.

3.—PRODUCTION OF SEED GRAIN.

The methods of ascertaining whether or not samples of grain coming under observation are fit for seed purposes have been outlined but equally important is the question of producing seed grain that will successfully pass such an examination.



WINTER WHEAT SEEDED AT THE RATE OF 30 LBS. TO THE ACRE.

Changing Seed.—The idea is prevalent in some districts that it is necessary to change seed every few years, in order to keep up the standard of a crop. This may be required in countries where an inferior product is grown; but in the Canadian West it is certainly not needed, as the cereal crops here reach an excellence unsurpassed anywhere. Grain grown under conditions favourable to healthy vigorous growth does not deteriorate in quality and may be continued indefinitely on the same farm without a change. Changing seed is often the cause of bringing in new noxious weeds, and new undesirable impurities of variety. This does not mean that it is never desirable to change. If, through carelessness or misfortune, a farmer's crop has become badly mixed, badly infested with weeds, or very smutty, it is certainly advisable to get in new, clean seed. But a change merely for the sake of a change is valueless.

Fanning Seed Grain.—A great deal can be done to improve seed grain by a thorough use of the fanning mill. It is true that the fanning mill is powerless to separate a mixture of varieties or to remove certain of the worst weed seeds, but on the other hand, the seeds of nearly all the common weeds can be taken out with it. The light shrunken kernels are also taken out. Seed grain should be run through at least twice and all the light kernels removed. Such a course will make a difference of several bushels per acre in the yield. It will also help to keep up the quality of the product.

Growing Seed on Special Ground.—There is on the average Alberta arm some crop grown on new land, some on summer fallow, and some on stubble. There is thus a variation in cleanliness among the various fields. In some there is nothing growing but what was sown, in others there are weeds and a volunteer crop. The grain intended for seed purposes should always be grown on the best and cleanest ground on the farm. If there is new land, broken early and well cultivated, that is the proper place. Where there is no new ground, a clean summer fallow is good. Wherever conditions are best, an area large enough to produce the seed for next year's crop should be set apart. This land should receive extra attention. It should be well worked up; the seed should be the best procurable and put in at the most favourable time; such extra attention as pulling weeds, or foreign grains, might be given to this area where time would not allow it to be done on the whole farm.

Hand Selection.—The underlying principle in the hand selection of seed grain is the variation distinguishable only by the human mind amongst the various plants in a field. It is impossible for the fanning mill or any other machine to distinguish between a seed of Alberta Red wheat and one of the same size and weight of Odessa wheat, or to distinguish between a seed grown in a wheat plant that produced twenty heads each with ten four-seeded spikelets in each side, and one grown on a wheat plant that produced one head with six two-seeded spikelets on each side. Such a variation exists. There is also the variation in stiffness of straw, earliness, resistance to smut or other disease and in many other characteristics. The method of hand selection of seed is to pick heads from plants of the right type, from a standing field of grain, considering the various points of excellence towards which it is desirable to improve the variety. Enough should be gathered to sow at least $\frac{1}{4}$ acre. Working with a smaller quantity there is a greater danger of losing the purity in the longer time required to produce a large amount. From this $\frac{1}{4}$ acre or more of the product of hand selected seed the selection should again be made of the same amount, and so on from year to year. Each year the product from the hand-selected plot should be sown on specially prepared ground, as outlined in the previous paragraph, and the second generation will produce enough seed for a large farm. Only by some such system of selection as this can the best results in keeping the grain crop pure be obtained. It is not practicable for every farmer to follow this system. Many have not the skill nor the carefulness to do it properly. But a few of the best farmers in every neighborhood producing pure-bred seed in this way would be a great benefit to the country. Those who

practice hand selection find that the increase in the yield more than repays them for the work, and that any extra price received on account of purity and quality is clear gain.

4.—SMUT.

Smut is a fungus disease affecting the cereal crops. Stinking smut of wheat is the common kind which forms the ball, which is broken in threshing, handling, and soils or "tags" the wheat. Loose smut is the kind which attacks the oats and barley. It also attacks wheat, but is not so common as the stinking or ball variety. Loose smut when ripe breaks up into a powder and is blown away by the wind; it does not "tag" the grain. Smut reproduces by spores. These spores have the same place in the life of the smut plant as the seeds of wheat do in the wheat plant. They are extremely small, so small that a single spore if separated from the others could not be distinguished without a magnifying glass. Any single spore is capable of producing the smut disease. The black powdery material known as "smut" is nothing more or less than a mass of myriads of these spores. When a grain of any cereal crop is sown with some of these smut spores in it they germinate and grow as soon as it does. One or more of the smut plants forces its way into the soft tissues of the young grain plant. It then continues to grow between the tissues, takes possession of the head and produces smut again.

Smut is successfully killed in seed grain by the use of bluestone (copper sulphate) or formalin (40% decinormal solution of Formaldehyde). The proper strength to use is a much debated question. For sprinkling on, or for immersion for not more than 5 minutes, 1 lb. of bluestone to 10 gallons of water used on 10 bushels of seed is a safe rule. With formalin, 1 lb. of formalin in 30 or 35 gallons of water used on 30 bushels of seed is satisfactory for sprinkling or dipping 5 minutes or less. Recent experiments have shown that the most satisfactory results are obtained from soaking for an hour in a weak solution (1 lb. bluestone to 20 gallons of water). This thoroughly saturates the smut balls, which with the ordinary method are apt to break and reinfect the seed. Too strong a solution is equally dangerous with too weak, as it is likely to injure the vitality of the grain. The important consideration in treating seed for smut is to make sure that every part of every kernel is reached by the solution. The extremely small spores are hidden in all uneven spots on the surface of the grain, and are sure to escape if the treatment is at all careless.

There are many causes that affect the prevalence of smut. The nature of the season is one. Seasons vary greatly in the extent of the damage by smut. A reason for this is that in some years the grain crop is slow and backward in starting, and gives the smut a better chance to attack it. This is uncontrollable. But there are other causes that bring about the same result and are controllable. Some of these are poor cultivation, late or extremely early sowing, weak seed. Any of these place the grain crop under a disadvantage, and thus make it more susceptible to smut, and less able to throw off it or any other disease. It is usually the poor farmer that has the most smut. By a system of seed selection, such as outlined in a previous paragraph, much can be done to eliminate smut.

Section V.—SHIPPING AND HANDLING GRAIN.

For the proper regulation of the shipping and handling of grain, there are two acts in force in Canada, viz.: the Grain Inspection Act and the Manitoba Grain Act, both of which may be had on application to the Warehouse Commissioner at Winnipeg.

The provisions of these Acts are of the greatest interest to the farmer, and may be summed up shortly as follows:

1.—THE GRAIN INSPECTION ACT.

By the provisions of this Act a Chief Inspector, Inspectors or Deputy Inspectors are appointed after being examined and duly found qualified by a board appointed for the purpose. This board is called the Board of Grain Examiners and consists of persons who, in the opinion of the Governor in Council, are skilful enough to act in this capacity.

The Chief Inspector and every inspector and deputy is under oath for the proper performance of his duties, and may be called upon at any time between sunrise and sunset to inspect grain.

Official grades are provided under the Act and any person may be supplied with samples on application to the Chief Inspector, and a small charge may be made for the same.

If, however, a considerable portion of a crop be damaged any year so that it will not quite come up to the grades it otherwise would and its being so is considered detrimental to the producer, extra grades may be declared. These are called commercial grades and are decided upon by what is known as a Grain Standards Board appointed by the Governor in Council.

This board is summoned whenever the Chief Inspector or any three members of it think necessary.

Any person not satisfied with the grading awarded his car may appeal to the Chief Inspector, whose decision is usually final, but appeal may be made beyond him to the Grain Survey Board if such appeal is made within 24 hours after his decision is published, but nothing in the Act prevents anyone appealing directly to the Board without first appealing to the Inspector. The costs of the Board's decision must not be more than five dollars, and it is paid by the losing party in the dispute.

The Grain Survey Board for the west consists of six men nominated by the Winnipeg Board of Trade and three each by the Ministers of Agriculture of Manitoba and the Territories.

Cars need not be inspected in wet weather or after dark unless the owner assumes the responsibility for risk of damage or error.

A complete record is kept by the inspector of every inspection made.

Anyone using a certificate for other than the car and grain it is issued for is liable to three years' imprisonment or five hundred dollars fine, or both; and anyone attempting to bribe or interfere in any way with an inspector in the performance of his duties is liable to two years' imprisonment or two hundred dollars fine, or both.

All actions under this Act must be begun within six months after the fault.

Anyone may buy or sell grain by sample, regardless of grades if he chooses.

The fees for inspection are: Into or out of elevators, 25c per car load; for each cargo from elevators, 30c per thousand bushels, and must be paid on inspection but can be collected from the owner by the agent.

If a farmer is not satisfied with the grade he is getting from an elevator he may send a sample to the Chief Inspector, and if the grain proves better than has been paid for the elevator is bound to pay the difference. On the other hand if the grade is lower than what is paid for the farmer must refund to the elevator.

Weighmasters and assistants are provided, all acting under a Chief Weighmaster, who also may be the Chief Inspector, and each and all of these are under oath and guarantee bond for the proper performance of their duties.

Samples of grain for grading should be sent either to the Chief Grain Inspector, Winnipeg, or the Deputy Grain Inspector, Calgary.

2.—MANITOBA GRAIN ACT.

An officer known as the Warehouse Commissioner is appointed for the proper administration of this Act, and under him two deputies.

These officers are under oath not to be directly or indirectly interested pecuniarily in the grain trade.

Elevators.—There are two kinds of elevators and warehouses provided for in the Act, terminal and country.

Terminal elevators are those in which grain is stored in bulk according to grade, and where there are no special bins to preserve the identity of individual shipments. Grain so stored must, however, be produced on demand equal in quality and quantity to that deposited there by the owner.

Country elevators or warehouses may deal in grain, or a farmer may have his grain stored in a special bin if he wishes, and are described as follows in Section 29 of the Act:

Bins are allotted in order of application as soon as one is available, and no farmer is allowed to hold more than one bin at any one time to the exclusion of other applicants.

All elevators and warehouses in which grain is received, stored, shipped or handled, and which are situated on the right of way of any railroad, or on any siding or spur track connected therewith, depot grounds, or any lands acquired or reserved by any railroad company to be used in connection with its line of railway at any station or siding other than at terminal points, are declared to be public elevators or warehouses and shall be under the supervision and subject to the inspection of the Commissioner, and shall, for the

purpose of the following sections of this Act, be known and designated as public country elevators or country warehouses.

Every elevator or warehouse owner is licensed and bonded for the protection of the public and the rules for running the elevators or warehouses must be posted up in a conspicuous place in the elevator or warehouse.

Every lot of grain received must be entered in the books, with full particulars and a receipt issued bearing like particulars.

Grain in store, unless in a special bin, must be insured from fire by the elevator owner. If it is in a special bin it may be done only at the option of the owner.

Any farmer may instruct the elevator to forward his wheat to the terminal elevator, but must pay all charges and give up his storage receipt for one empowering him to demand a similar car from the terminal.

If grain is not delivered by the elevator or warehouseman within 24 hours after demand, and cars have been furnished, the owner may claim damages amounting to 1c per bushel, and an additional cent for every day of such delay, but a warehouseman is not bound to deliver grain except in the order demanded by different holders of receipts.

Grain which is stored in a special bin and which has become heated, must be reported to the Commissioner and the owner, and if it is not removed by the owner the warehouseman may sell it by auction. If other grain is spoilt by contact with it the elevator or warehouse owner may lose his license and forfeit his bond. Thus, as may naturally be expected, elevator men are very chary about taking damp or immature grain.

Any malpractices in the running of an elevator may be reported under oath to the Commissioner who is bound to investigate it.

Where elevators are equipped with proper machinery and it is in running order, any person may demand the cleaning of his grain and may see it done if he wishes, and all grain transactions must be recorded on the books of the elevator, which are open to the inspection of the Commissioner at any time.

Any person residing within 40 miles of his nearest shipping point may make application to the Commissioner for permission to erect a warehouse at any point convenient of access and approved of by the Commissioner, and the railway company must provide a site at the regular rental rates and also a siding for the use of the warehouse.

Such a warehouse must have at least three bins of 1,000 bushel capacity and it must be covered with metal. Bonds and a license are required as in the case of ordinary elevators.

Loading Platforms.—Any ten farmers residing within 20 miles of their nearest shipping point may apply to the Commissioner for a loading platform, and it must be erected in a convenient place and at a siding and must be at least 54 feet long and 18 feet wide.

No platform may be erected at a siding used only for crossing purposes.

The use of the platform is free and it must be erected by the railway company within thirty days after the Commissioner applies

for it under a penalty of not less than twenty-five dollars for each day of delay unless a strike or some such unavoidable cause prevents.

Applications for such platforms are received by the Commissioner only between April 15th and October 15th, and no railway company is compelled to build such platforms between the first of November and the first of May following.

If more cars are to hand than can be loaded at once, the others must be placed at points convenient for loading on the track.

Commission Agents.—After a commission agent has sold a car he must furnish within 24 hours after demand a full and particular account of the same to the owner.

Grain commission agents must operate under a license and have to furnish bonds in proportion to the business they transact.

Distribution of Cars.—Any person desiring to ship grain may demand a car from any railway company by applying to the nearest agent of that company.

A car order book authorized by the Commissioner must be kept at every station and allowed to remain in a public place, so that every man may have access to it, and in that book the person requiring a car must write his name at the foot of the list already there and await his turn for it.

No elevator, warehouse, or farmer can have more than one car at a time, and if a man wants another after his first order is filled he must put his name at the bottom of the list again.

Cars must be placed at any elevator, warehouse, loading platform or any convenient point of the siding at the option of the applicant.

If a car is placed loading must begin within 24 hours, otherwise the application may be cancelled.

Every car must be in good order and condition when it is allotted.

Anyone who sells or transfers his right to any car in any way is liable to a fine of not less than twenty-five and not more than one hundred dollars, and anyone who makes use of another name to obtain an extra car is liable to a similar fine.

It is not necessary for a farmer to make application for a car personally. He may do so through another party, after instructing him in writing, but the station agent may demand the instructions to be produced.

The railway agent is required to post up in a conspicuous place every day the cars allotted that day and the parties to whom they have been allotted.

Cars may be ordered for shipment to any point east or west from Fort William to the Coast.

3.—OFFICIAL GRADES OF GRAIN.

The following grades apply only to grain grown west of Port Arthur, this district being known as the Manitoba Inspection Division in contra distinction to the eastern inspection division, which consists of the rest of the Dominion lying east of Port Arthur.

SPRING WHEAT.

No. 1 Manitoba hard wheat shall be sound and well cleaned, weighing not less than 60 pounds to the bushel, and shall be composed of at least seventy-five per cent. of hard red Fife wheat.

No. 1 hard white Fife wheat shall be sound and well cleaned, weighing not less than 60 pounds to the bushel, and shall be composed of not less than sixty per cent. of hard white Fife wheat, and shall not contain more than twenty-five per cent. of soft wheat.

No. 1 Manitoba northern wheat shall be sound and well cleaned, weighing not less than 60 pounds to the bushel, and shall be composed of at least sixty per cent. of hard red Fife wheat.

No. 2 Manitoba northern wheat shall be sound and reasonably clean, of good milling qualities and fit for warehousing, weighing not less than 58 pounds to the bushel, and shall be composed of at least forty-five per cent. of hard red Fife wheat.

Any wheat not good enough to be graded as No. 2 Manitoba Northern shall be graded No. 3 Manitoba Northern in the discretion of the inspector.

Scoured wheat shall not be graded higher than No. 3 Manitoba Northern.

WINTER WHEAT.

No. 1 Alberta red winter wheat shall be hard, pure, red winter wheat, sound and clean, weighing not less than 62 pounds to the bushel.

No. 2 Alberta red winter wheat shall be hard, red winter wheat, round and clean, weighing not less than 60 pounds to the bushel.

No. 3 Alberta red winter wheat shall include hard, red winter wheat, not clean enough nor sound enough to be graded No. 2, weighing not less than 57 pounds to the bushel.

OATS.

Extra No. 1 Manitoba oats shall be white, sound, clean and free from other grain, shall contain 95 per cent. of white oats, and shall weigh not less than 38 pounds to the bushel.

No. 1 Manitoba oats shall be sound, clean and free from other grain; shall contain 90 per cent. of white oats, and shall weigh not less than 35 pounds to the bushel.

No. 2 Manitoba oats shall be sound, reasonably clean, reasonably free from other grains, and shall weigh not less than 34 pounds to the bushel.

No. 3 oats shall be sound but not clean enough or sufficiently free from other grain to be graded as No. 2, and shall weigh not less than 34 pounds to the bushel.

Any oats not good enough to be graded No. 2 shall be graded No. 3 in the discretion of the inspector.

BARLEY.

No. 1 Manitoba barley shall be plump, bright, sound, clean and free from other grain.

No. 2 Manitoba barley shall be reasonably clean and sound but not bright and plump enough to be graded as No. 1, and shall be reasonably free from other grain, and weigh not less than 48 pounds to the bushel.

No. 3 extra Manitoba barley shall be in all respects the same as No. 2 barley, except in colour, weighing not less than 47 pounds to the bushel.

No. 3 Manitoba barley shall include shrunk or otherwise slightly damaged barley, weighing not less than 45 pounds to the bushel.

No. 4 Manitoba barley shall include all barley equal to No. 3, weighing not less than 45 pounds to the bushel.

RYE.

No. 1 Manitoba rye shall be sound, plump and well cleaned.

No. 2 Manitoba rye shall be sound, reasonably clean and reasonably free from other grain.

All rye which is from any cause unfit to be graded as No. 2 rye, shall be graded as "rejected."

FLAX SEED.

No. 1 North-western Manitoba flax seed shall be mature, sound, dry and sweet, and contain not more than 12½% of damaged seed and weigh not less than 53 pounds to the bushel of commercially pure seed.

No. 1 Manitoba flax seed shall be mature, sound, dry and sweet, and contain not more than twenty-five per cent. of damaged seed, and weigh not less than 52 pounds to the bushel of commercially pure seed.

All flax seed which is immature or musty or which contains more than twenty-five per cent. damaged seed and is fit for warehousing and testing not less than 49 pounds to the bushel of commercially pure seed shall be "rejected."

Flax seed that is damp, warm, mouldy, musty or otherwise unfit for warehousing shall be classed "no grade."

To test flax seed, one pound of average seed shall be taken from the sample tested, and the impurities or foreign matter therein shall be removed as near as possible by the use of two sieves of thirty-two gauge wire cloth, one with meshes three by sixteen and the other with meshes sixteen by sixteen to the square inch. The percentage of impurities and weight per bushel of the commercially pure seed shall be determined by the use of proper testing scales.

PROVISIONS AS TO ALL GRAIN.

1. All good grain that is slightly damp, or otherwise unfit for warehousing, shall be entered on the inspecting officer's books as "No grade," with his notations as to quality and condition. All good grain that contains a large admixture of other kinds of grain shall be classed "No grade."

2. All grain that is in a heating condition or is badly bin-burnt, whatsoever grade it might otherwise be, shall be reported and entered upon the inspecting officer's books as "condemned," with the inspector's notations as to quality and condition.

3. Any grain that is unsound, musty, dirty, smutty, sprouted, or from any other cause is unfit to be classed under any of the recognized grades, shall be classed "rejected."

4. All grain shall be weighed and the weight per bushel recorded in the inspecting officer's books.

5. No grain that has been subject to scouring or treatment by use of lime or sulphur shall be graded higher than No. 3.

6. In the inspection of grain the weight alone shall not determine the grade.

7. All inspecting officers shall make their reasons for grading grain, when necessary, fully known by notation on their book.

